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DEPARTMENT OF AGRICULTURE

OCTOBER 1, 1987 - SEPTEMBER 30, 1988
FY 1988

Guam
Aquatic
and
Wildlife
Resources
Annual
Report
FY '88

FISCAL YEAR 1988

**GUAM
AQUATIC & WILDLIFE RE
Harry T. Kam**

PERIOD COVERED
October 1, 1987 to September 30, 1988

October 1, 1987 to September 30, 1988

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Base Commanders of the U.S. Naval Magazine, Naval Facility, Naval Station, Naval Communications Station and the Andersen Air Force Base;

Security Officers and their staffs at the U.S. Naval Magazine, Naval Station, Naval Communication Station, and Andersen Air Force Base;

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The Marine Lab, University of Guam;

Special Agent Bobby T. Shibazaki, Office of Enforcement, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce

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COORDINATION AND ADMINISTRATION
PROJECT FW-2R-25
(Federal Aid in Fish and Wildlife Restoration Acts)

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-25
SUB-PROJECT NO.: C-1
JOB NO.: 1

JOB TITLE: Coordination of Guam's Fish and Wildlife Programs

PERIOD COVERED: October 1, 1987 to September 30, 1988

OBJECTIVES

To plan, coordinate, supervise, and administer all Fish and Wildlife Restoration Programs.

PROCEDURES

1. Supervise the planning and documentation of the Fish and Wildlife programs.
2. Administer all fiscal and budgetary matters and coordinate with the Central Accounting and Budget Office.
3. Administer all personnel matters including recruitment of off-island staff.
4. Represent the Division and Department of Agriculture in all matters pertaining to Fish and Wildlife Resources.

RESULTS

The Division Chief and his staff were involved in preparing required documentation for the DJ-PR funded Guam Fish and Wildlife Investigation Program (FW-2R) and the Guam Endangered Species Program (E-1) funded under a Section 6 Cooperative Agreement. Documentation included various Project Agreement and AFA amendments and the Project Agreement for Segment 26.

Fiscal and budgetary activities included monthly preparation and submission of reimbursement vouchers for our various Federal Aid programs and coordination with the Government Accounting and Budget Offices to ensure fiscal integrity.

The Division Chief and his staff represented the Division and the Department of Agriculture in all matters relating to fish and wildlife resources. This frequently entailed meetings with other agencies of the Government of Guam, various Federal agencies, and the military.

Division staff made a number of off-island trips related to Federal Aid programs. Division Chief Harry Kami attended the Federal Aid Coordinators meeting in October which was held in Ocean Shores, Washington. He also spent one day conferring with the U.S. Fish and Wildlife Service in Honolulu, Hawaii.

While on vacation on the East Coast in December, Wildlife Biologist Robert Beck spent two days at the Conservation Research Center, National Zoological Park, in Front Royal, Virginia, meeting with Dr. Scott Derrickson, Curator of Birds, who is coordinating the participation of mainland zoos in the captive breeding program for the Guam Rail. They discussed the status of the program and the planned introduction of the Guam Rail to the island of Rota.

Robert Beck traveled to Rota in February to investigate prospective release sites for the introduction of the Guam Rail to Rota. He was accompanied on this trip by Dr. Scott Derrickson from the National Zoological Park. While on Rota, they met with various officials of the Commonwealth of the Northern Mariana Islands and Rota municipal governments. They also made arrangements to purchase a vehicle for the use of the graduate student who will be monitoring the success of the introduction project for several years. Beck made a second trip to Rota in June, accompanied by Michael Ritter and Herman Muna to construct holding cages for the planned rail release.

Wildlife Biologist Paul Conry attended the Annual Meeting of the Western Section of The Wildlife Society, which was held in Hilo, Hawaii in February. He presented a paper entitled "Management of Introduced, Feral, and Exotic Game species on Guam.

Wiles visited Rota in August, conducting surveys of Marianas fruit bats in conjunction with biologists from the Commonwealth of the Northern Mariana Islands (CNMI). Wildlife Biologist Gary Wiles made a second trip to Rota in February, accompanied by Gordon Rodda of the U.S. Fish and Wildlife Service and Jesse Guerrero of our office, for the purpose of conducting a reptile survey for inclusion in the Environmental Assessment for the Guam Rail Introduction Program.

Division Chief Harry Kami, accompanied by Fishery Biologists Robert Myers, Gerry Davis, Tim Sherwood, and Gretchen Grimm traveled to Saipan in May to participate in a joint fisheries workshop hosted by the Fishery Section of the CNMI Division of Fish and Wildlife.

In July, our Wildlife Section hosted a similar wildlife workshop on Guam that was attended by the wildlife staff from the CNMI Division of Fish and Wildlife.

The Division hosted a number of off-island visitors during the year. Ernie Kosaka, John Ford, Derral Herbst, Tom Fritts, and Gordon Rodda, all of the U.S. Fish and Wildlife Service, visited the office at various times. George Marshall, Gene Witham, and Bobby Shibazaki of the National Marine Fisheries Service also visited. In addition, Len Newell of the U.S. Forest Service and Jerry Norris of the Pacific Basin Development Council also met with the Division.

Numerous representatives of the CNMI Department of Natural Resources, including Biologists Phil Glass, Jim Reichal, Stan Villagomez and Stan Taisapic, visited during the year to discuss subjects of mutual interest.

The Division experienced several staff changes during the year. Conservation Officers Danny Wolford, Johnny Taitague, Leonard Iriarte and Arnold Marcus plus Biological Aid Anthony Cruz left the Division during the year. Gerry Davis was promoted to Fishery Biologist IV. Additions to the staff included Public Information Officer Lillian Mariano,

Wildlife Biologist III Michael McCoid, Wildlife Biologist I Michael Ritter, Biological Aids Esther Arca and Glenn San Nicolas, and Conservation Officer Roger Watson.

Report prepared by: Robert D. Anderson

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-25

SUB-PROJECT NO.: C-2

JOB NO.: 1

PROJECT TITLE: Technical Guidance to Projects Affecting Guam's Fish and Wildlife Resources

JOB TITLE: Technical Guidance to Projects Affecting Guam's Fish and Wildlife Resources

PERIOD COVERED: October 1, 1987 to September 30, 1988

BACKGROUND

The rapid development of Guam's economy has placed increasing demands upon Guam's natural resources. A trend toward urbanization has brought growth in the construction of residential, recreational, commercial, military, industrial, and public utility facilities, all of which have some impact upon the environment. To help minimize long-term adverse impacts of such development, the Division of Aquatic and Wildlife Resources (DAWR) has taken an increasingly active role in the area of technical guidance. Recently, the DAWR's responsibilities in this area have been increasing rapidly because review is now legally required for many development plans, permit applications, and impact statements.

OBJECTIVES

1. To minimize adverse impact resulting from the construction of recreational, commercial, residential, industrial or public utility facilities.
2. Provide technical assistance to military and civil agencies relative to the management and protection of fish and wildlife resources.

FINDINGS

The staff of the Division has been actively involved in the technical guidance function during this segment. Numerous development plans, impact statements, and permit applications have been submitted to the Division for review. Field investigations and meetings with responsible agencies have been conducted in many cases as a part of the review process.

Various Division staff members actively serve as members of the following groups:

1. Ad Hoc Fisheries Council
2. Region IX Regional Response Team - Oceania
3. Brown Tree Snake Task Force
4. Subdivision and Development Review Committee
5. Agricultural Lease Committee
6. Melon Fly Task Force
7. Fish and Wildlife Conservation Committee- Andersen Air Force Base
8. Fisheries Task Force

Members of the Division have attended numerous meetings and hearings pertaining to the protection of Guam's natural resources and have actively consulted with various civil and military agencies on environmental matters. Division staff maintain close liaison with the Department of Land Management, Department of Parks and Recreation, Guam Bureau of Planning, Guam Environmental Protection Agency, U.S. Army Corps of Engineers (ACOE), the U.S. Fish and Wildlife Service, the National Marine Fisheries Service, the U.S. Navy, the U.S. Coast Guard, the U.S. Air Force regarding matters of environmental concern. In addition, staff members actively consulted with the numerous off-island visitors, representing various agencies and organizations, who visited during the segment.

Considerable public contact was maintained by Division staff during the reporting segment. In addition to occasional interviews on radio, television, and in newspaper, staff members participated in National Wildlife Week, Chamorro Week, Earth Week and Environmental Fair activities and gave talks to a number of civic groups, sportsman clubs, and school and university classes.

Some specific Technical Assistance activities included:

1. The Division was represented on the Subdivision and Development Review Committee, which met bi-weekly to review applications for rezoning, variances, and various types of development. The Division's input at this level is very important in ensuring that the protection of Guam's fish and wildlife resources be considered in land use planning.
2. The Division provided technical assistance to Andersen Air Force Base regarding the problem of excluding deer from flightline areas and reducing populations to optimum levels. This assistance included providing information, technical advice and special either-sex control hunts.
3. The Division reviewed and commented to GEPA on the impacts of dredging a swimming area at the beachfront of the Pacific Islands Club Hotel.
4. The Division reviewed the final EIS for the proposed clean-up of refuse dumped by the Air Force on privately-owned land in the Urunao Basin area.

5. The Division reviewed several proposed subdivision developments for potential impacts on endangered species. Because these projects were to be federally financed, the developers and the funding agency (Farmers Home Administration) were also referred to the U.S. Fish and Wildlife Service.
6. The Division reviewed and commented upon several legislative bills that would affect fish and wildlife resources.
7. The Division reviewed and commented upon TSPC Seashore Clearance and ACOE permit applications to dredge an area of East Agana Bay for the purpose of improving disposal of stormwater runoff and to provide an area for the commercial operation of mechanized aquatic recreational vehicles such as jet skis.
8. The Division assisted in the preparation of several Agricultural Impact Statements which are required in cases involving the rezoning of lands zoned "A" (Agricultural). In cases where the proposed rezoning would have negative impacts on the conservation of wildlife resources recommendations were made to disapprove the proposed rezoning.
9. The Division reviewed and commented on several proposals to dispose of government land through sale or exchange and made appropriate recommendations for the conservation of wildlife resources.
10. The Division reviewed and commented on the Micro-Dredging Plan for Tumon Bay proposed by Public Works and the Guam Visitors Bureau that would dredge a 300 ft. strip parallel to and 150-170 ft. from the shore for the entire length of the Bay.
11. The Division reviewed and commented to Public Works and other concerned agencies on the plan to widen E. O'Brien Drive and the potential impact on the resources and the adjacent watershed.
12. The Division met with Government agencies and provided information on several occasions regarding the user conflict between mechanized craft and fishermen in East Agana
13. The Division investigated several reports of suspected fish kills in island waters during the year.
14. The Division responded to many requests for information on laws and regulations pertaining to fish, wildlife, endangered species, hunting and fishing and importation of wildlife.
15. The Division reviewed and commented on the Agana Spring Water Source Development and associated impacts.
16. The Division responded to many requests for information on native wildlife, particularly endangered species.
17. Division staff met occasionally with supervisors of the Customs and Quarantine Division to discuss animal imports and endangered species questions.

18. The Division reviewed the status of the Micronesian Kingfisher in a Section 7 opinion issued under the requirement of the Endangered Species Act by the U.S. Fish and Wildlife Service and issued a rebuttal based inadequate consideration given to the protection of the remaining birds.
19. The Division reviewed and commented on the impacts to fisheries resource under the proposed blasting described in the construction of the ammunition wharf in Apra Harbor at Orote Point. Mitigation procedures were provided in the response.
20. The Division reviewed and provided general comments to the U.S. Navy regarding their proposal to place a fence around the Naval Magazine boundaries.
21. The Division Chief served as the Department's Response Activity Coordinator with Civil Defense. Division staff were involved in conducting natural resource damage assessment in the aftermath of Typhoon Roy and Lynn.
22. The Division reviewed and commented upon the ACOE application to fill 2.5 acres of wetland in Agana Swamp for the expansion of the Agana Shopping Center. Mitigation recommendations were included in the comments.
23. The Division reviewed and commented on the Draft National Wetland Priority Conservation Plan and made appropriate recommendations for the conservation of wildlife resources.
24. The Division answered numerous requests for information on hunting from both on and off-island individuals. Specific requests included information on protective coloration, bow hunting, and laws and regulations.
25. The Division responded and monitored a reported fuel spill in Toto near Agana swamp. No measurable detrimental environmental impacts resulted from this event.
26. The Division provided information to the Department of Commerce on Guam's annual fisheries harvest and harvest estimates to the Guam Visitors Bureau for the Guam International Fishing Derby.
27. The Division provided information on numerous occasions on aspects of the proposed rail introduction to both on and off-island individuals and agencies.
28. The Division provided information and technical recommendations to the Attorney General's office regarding needed revisions to the regulations regarding fish weir permits and attending meetings to discuss proposed alterations.
29. The Division provided comments to the Bureau of Planning on the resource impacts resulting from the proposed dredging of the Jones Beach swimming area.
30. The Division contacted and met with officials from Andersen Air Force Base and the Navy regarding the disturbance of nesting Marianas Crows, an endangered bird, by low flying helicopters.

31. Division staff provided technical assistance to the Air Force on several occasions by identifying the remains of birds and bats involved in collisions with aircraft.
32. The Division reviewed and commented on the latest version of the Army Corps of Engineers Agana River Flood Control Plan and attended meetings to review the supplemental EIS.
33. The Division reviewed and commented upon a Bureau of Planning study entitled "Public Access To Shoreline Areas."
34. Division staff provided technical assistance to numerous farmers and the Air Force and the Navy regarding pig damage. Damage control permits were issued when warranted.
35. Several Division staff reviewed manuscripts for other authors and for professional journals.
36. The Division provided technical assistance to the South Pacific Commission by reviewing annual work plans providing information on fishing activity, and reviewing a Tuna/Billfish assessment.
37. The Division provided technical assistance to the Attorney General's Office in identifying fish killed illegally with explosives, hair and other tissues from suspected deer and pig carcasses, and in interpreting the laws and regulations that apply to fish and wildlife resources.
38. Division staff attended hunter safety briefings at Andersen Air Force Base to provide pertinent information to hunters.
39. Division staff made presentations on fish and wildlife resources at meetings of numerous clubs and other organizations during the year.
40. Division staff prepared numerous press releases to keep the public informed of fish and wildlife issues including hunting seasons, laws and regulations, endangered species, fish and wildlife importation, etc.
41. The Division reviewed and provided comments to the ACOE on a proposal by the Navy to remove four unexploded Japanese depth charges from the wreck of the TOKAI MARU in Apra Harbor and detonate them in the harbor. The removal and detonation was intended to remove a significant hazard to recreational divers who visit the wreck. The recommendation was made that the depth charges be removed from the wreck and towed into deep water outside Apra Harbor where they could either be detonated with minimal environmental damage, or jettisoned and sunk in deep water where they would no longer present a hazard.
42. The Division provided information to the South Pacific Commission regarding Guam's commercial and subsistence fisheries.
43. Technical assistance was provided to the Marianas Fishing Derby.
44. Technical assistance was provided in the South Pacific Games spearfishing qualifying tournament

45. Technical information on the state of Guam's fish and wildlife resources was provided to the Guam Environmental Protection Agency for their annual report.
46. Technical assistance and logistical support was given to Drs. Thomas Fritts and Gordon Rodda of the U.S. Fish and Wildlife Service, each of whom spent time on Guam consulting with Division staff on the brown tree snake .
47. The Division worked closely with the Navy and Fish and Wildlife Service in completing the revision of the Sikes Act Cooperative Agreement with Naval Magazine and establishing new agreements with six other Naval installations on Guam.
48. The Division reviewed and commented on the proposed Andersen Air Force Base Hunting Regulations and worked closely with their staff in planning special either-sex control hunts for deer.
49. The Division reviewed the Parks and Recreation project entitled "The Agana Shoreline Restoration and Beautification Project."
50. The Division reviewed and commented to the ACOE on the impacts of constructing applications for three piers in Cabras Lagoon to serve three tour companies conducting dinner cruises and charter trips.
51. The Division provided comments on the fisheries section of the Overall Economic Development Plan for the Fisheries to the Department of Commerce.
52. The Division reviewed and commented to the Bureau of Planning on the proposed VERTEP HELIPAD planned for Naval Station. The Division recommend revising plans to avoid the mangrove area.
53. The Division provided fisheries information to the Bureau of Planning for the development of a Water Use Master Plan for the area between Alupang Cove and the USO.
54. The Division reviewed and commented on the impacts on the proposed relocation and construction plans for the Marianas Yacht Club for Port Authority property on Dry Dock Point.
55. The Division reviewed and commented to SDRC on the proposed 17 story condominium complex to be constructed on E. Agana beachfront and the request for a height variance and seawall encroachment into the seashore preserve. Comments included fishery and environmental concerns. The Division opposed award of the height variance due to insufficient hardship on the land, opposed the encroachment because of restricting public access and environmental damage and felt the condominium would have a substantial negative impact on existing subsistence and traditional fisheries in East Agana Bay.
56. Responded to a Bureau of Planning request regarding Division responsibilities in the Exclusive Economic Development Zone.

57. The Division commented on an ACOE application to dredge a slip in Apra Harbor to berth a tourist submarine.
58. The Division reviewed and commented on the scope of work proposed in an environmental baseline survey for coastal property in Talofoto and Pauliluc Bays
59. The Division reviewed and commented on the 60% submittal plans for reconstruction of Rt. 3 proposed by PWC.
60. The Divisions Fisheries staff provided training in the identification of illegally taken fish to the Divisions Conservation Officers. The staff also identified two illegally imported fish species (snakeshead and barrimundi) intended for aquaculture purposes.
61. Division responded to questionnaire surveys on the Wallop-Breaux program and assaults on Conservation Officers.
62. The Division provided technical assistance to the U.S. Fish and Wildlife Service through the review of draft recovery plans for endangered fruit bats, native forest birds, the Vanikoro Swiftlet, and the Mariana Moorhen.
63. A Division staff member assisted the Commonwealth of the Northern Mariana Islands Fish and Wildlife Division in conducting surveys of Mariana fruit bats on the island of Rota.
64. A member of the Division staff participated as a member of the IUCN Species Survival Commission for fruit bats, provided information on the trade in fruit bats, and reviewed and commented upon a CITES proposal to extend CITES protection to Pacific Island fruit bats
65. The Division reviewed and commented upon the Army Corps of Engineers Agana Bay Typhoon Storm Surge Protection Plan and attended meetings to discuss problems with the proposed plans.

Report prepared by: Gerald Davis

JOB PROGRESS REPORT INFORMATION/EDUCATION PROGRAM

STATE: Territory of Guam

PROJECT NO.: FW-2R-25
SUB-PROJECT NO.: C-3
JOB NO.: 1

JOB TITLE: Public Information and Education of Guam's Fish and Wildlife Restoration and Endangered Species Programs

PERIOD COVERED: October 1, 1987 to September 30, 1988

SUMMARY

The Division of Aquatic and Wildlife Resources' (DAWR) Public Information/Education Program was re-implemented in March 1988, with the recruitment of a Public Information Officer (PIO). Since then, efforts have included the review, update, and expansion of existing conservation education materials, and the development of other contemporary materials. Public exhibits and talks on the brown tree snake have been made, and school talks on fish and wildlife conservation are ongoing. Preliminary planning for the implementation of the aquatic/hunter education program has also been started.

BACKGROUND

In 1979, the Division of Aquatic and Wildlife Resources (DAWR) recruited its first Public Information Officer (PIO) under a grant from the Coastal Zone Management (CZM) program administered by the Guam Bureau of Planning. The DAWR subsequently made considerable inroads in helping to develop a conservation ethic which was sorely lacking not only in the schools but in the home, and throughout the community as well. Fish and wildlife posters and fact sheets were printed, public service announcements focusing on conservation education were developed, and various curriculum materials were printed off and distributed to Guam's elementary and secondary school children. A community, once oblivious to its environment and natural resources, gradually began to realize and appreciate the importance and value of conserving and preserving a vital part of Guam's natural history. Residents are responding positively, as evidenced by the number of bird sighting calls received, anonymous tips on poaching activities, and residents bringing in birds thought to be endangered species. Due to a reduction in overall funding levels, the Bureau of Planning did not renew the CZM grant to DAWR in 1983 and the PIO was transferred to Bureau of Planning. Funding uncertainties did not permit DAWR to recruit another PIO until March 1988.

PROCEDURES AND RESULTS

To date, activities and efforts include:

1. The review, update and expansion of currently-available fish and wildlife conservation/education materials. The high demand for fish and wildlife posters and animal flyers from teachers, students, and the public in general, is

indicative of the gradually-increasing public awareness, appreciation, and concern for our resources;

2. Development of Public Service Announcements (PSAs) on a variety of concerns including fish and game conservation, impacts of illegal hunting and fishing, preservation of coral reefs, endangered species, fish and wildlife habitats and the adverse impact of brown tree snakes on native birds. Scripts have been completed and production is being scheduled;
3. Development of a pamphlet entitled "All You Want to Know about the Brown Tree Snake". Presented in a simple question-and-answer format, the pamphlet addresses questions most often asked by the public on the brown tree snake, i.e. snake behavior, habitat, food preference, and its threat to humans. Further, it alerts the reader on the snake's devastating impact on endangered species, and provides instructions on building traps. Snake recipes are also included.
4. Publication of feature article on seasonal rabbitfish runs; news releases on endangered species, coral reef, special deer hunt, Black Francolin hunt, and other related fish and wildlife activities. Other features lined up for publication include the impact of illegal fishing methods on Guam's coral reefs and other sea life, and an overview of the "koko" (Guam Rail) and "sihek" (Micronesian Kingfisher) captive-breeding programs;
5. Development of fish and wildlife awareness/conservation education slide shows for use in school presentations;
6. Public exhibit of live brown tree snakes, complimented by an information board explaining among other things, the biology of the snake, its point of origin, government efforts to prevent its spread to surrounding Pacific islands, and its impact on native forest birds and electrical power facilities. The snake display has been exhibited at agricultural and cultural fairs, the anniversary celebration of the War in the Pacific National Historical Park, and the open house at Andersen Air Force Base. An estimated 25,000 to 30,000 residents and tourists have viewed the display;
7. Production of an eight-minute public awareness videotape on the brown tree snake and how it has impacted Guam in terms of its wildlife resources and power facilities. The tape was produced during a two-week basic video production course conducted by the South Pacific Commission in August. It was produced and directed entirely by class participants, including the DAWR's Public Information Officer. DAWR provided the snakes for filming and rendered assistance whenever needed. The tape has been reviewed for content and accuracy by DAWR staff. It is currently being screened for broadcasting on KGTF Public Television, KUAM TV, Cable TV, and TV 14.
8. Preliminary planning for the implementation of an aquatic/hunter education program (pending the February 1989 arrival of a U.S. Fish and Wildlife Service instructor who will be conducting a workshop on the development of an effective aquatic-hunter education program). In the interim, the proposed strategy calls for summer workshops for teachers using wildlife and fisheries biologists, and extension agents from the University of Guam as instructors. Considerable thought is being given to ensure that such a program will fit Guam's situation and above all, be interesting and innovative enough to attract

teachers and motivate them into instituting a program of their own design in their classroom upon completion of their training. The workshop would include both classroom and field sessions, and possibly an overnight campout. Proposed topics include the evolution of fishing and hunting on Guam, the coral reef, fish and game identification, fishing/hunting methods and equipment demonstration, review of Guam's fishing and hunting laws, rules and regulations, fish and game conservation, management, safety, ethics, and how to catch, clean and cook fish and game. Other aspects such as incentives for participating teachers, number and duration of sessions and class size, are also being explored.

RECOMMENDATIONS

Much remains to be done in the area of conservation awareness and education. Existing programs have undoubtedly proven to be effective to a certain extent. However, there is still a lack of conservation ethics that prevails in certain segments of Guam's population. Illegal hunting and fishing activities continue despite diligent efforts by conservation officers. It is felt that while conservation education efforts should be tailored for the community in general, such efforts should be intensified in the elementary and middle school levels where children are more easily influenced. School talks and information materials have been well-received and, students overall, appear to be well on their way to becoming guardians of Guam's natural resources. In order therefore, to maintain and further enhance this trend, additional conservation education materials and activities need to be developed and implemented.

Report prepared by: Lillian L. Mariano

GUAM FISHERIES INVESTIGATIONS
PROJECT FW-2R-25
Federal Aid in Sport Fish Restoration Act

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-25

SUB-PROJECT NO.: F

STUDY NO.: F-1

JOB NO.: 1

JOB TITLE: Offshore Fisheries Survey

PERIOD COVERED: October 1, 1987 to September 30, 1988.

SUMMARY

Monthly offshore fisheries surveys were conducted at the Agana Boat Basin and other boat launching locations along Guam's shoreline from October 1987 through September 1988. An island-wide finfish catch is estimated at 380.2 metric tons (m.t.) for that period. The bulk of the catch, 341.7 m.t., was landed by trolling during an estimated 57,365 boat-hours of effort. The bulk of the troll catch, 325.7 m.t., consisted of five major pelagic species. Bottomfishing produced an estimated 24.5 m.t., primarily snappers and emperors, followed by spearfishing (10.5 m.t. of finfishes and 1.6 m.t. of shellfish) and night-light jigging for atulai (3.0 m.t.). Approximately 0.5 m.t. of finfish and 0.3 m.t. shellfish were caught by hand or gill net. (Catches by infrequently encountered methods may be under-estimated as follows: night-light jigging for atulai (25%); spearfishing (26%); and other methods combined (14%).)

BACKGROUND

Effective management of the island's offshore fishery resources requires accumulating data on fishing pressure, types of fishing methods used and annual harvest. In order to identify trends in fishing participation, effort, and catch, the Division of Aquatic and Wildlife Resources (DAWR) has been monitoring offshore fishing activities for the past eleven years. Over this period of time, survey and analysis methodologies have changed in response to fluctuations in budget and staff. Recently, however, major advances have been made in both field survey techniques and in the area of computerized statistical analysis. Much of this progress has resulted from the combined efforts of DAWR and National Marine Fisheries Service (NMFS) personnel through the Western Pacific Fisheries Information Network (WPACFIN) program (see Study F-1, Job 3).

OBJECTIVES

1. To quantify fishing participation, effort, and catch which occurs outside the reef margin in boats.
2. To collect biological data from the specimens examined during interviews.

PROCEDURES

During FY 88, interviews of returning offshore fishing parties were conducted on four days each month at the Agana Boat Basin. Two of these days were randomly selected weekdays and two were randomly selected weekend days (which in this report includes holidays). Each survey consisted of two periods, one from 0500 to 1100 hours and the other from 1600 to 2400 hours. Island-wide participation was determined by means of a morning and evening survey of all public boat launching areas in which all trailers attached to vehicles were counted, but no interviews were taken. This assumes that the proportion of boat trips participating in fishing to boat trips not participating in fishing for boats utilizing the Agana Boat Basin is representative of the island as a whole.

Sampling and analytical procedures used in the GOES (Guam offshore expansion system) and by the Division remain basically unchanged from those outlined in the FY 85 annual report. The following changes were implemented in response to observations of fishing activity during the three-day Guam International Fishing Derby (GIFD): trolling and bottomfishing activity by non-derby participants was negligible, so the statistics for the month of August and for the year for those methods are based on 28-day and 363-day expansions with the GIFD results added for trolling, respectively; participation in other fishing methods seemed unaffected by the GIFD, so statistics for those methods are based on 31- and 366-day expansions for August and the year, respectively*. An explanation of the field method of determining number of berthed boats considered out of port is given in the FY 87 annual report.

RESULTS

Trolling

An estimated 341.7 m.t. of troll-caught fish were landed island-wide during FY 88 (Table 1). Monthly catches ranged from a high of 77.5 m.t. in March to a low of 7.1 m.t. in October (Figure 1). An estimated 57,365 boat-hours were spent trolling with an average catch rate of 6.0 kg/boat-hour. Monthly catch rates (CPUE) ranged from 9.5 kg/boat-hour in March to 2.2 kg/boat-hour in January.

The usual five pelagic species accounted for the bulk of the catch (95.4%; Table 2). Mahimahi (*Coryphaena hippurus*, 42.8%) was the most important species, followed by skipjack tuna (*Katsuwonus pelamis*; 23.3%), wahoo (*Acanthocybium solandri*; 11.2%), yellowfin tuna (*Thunnus albacares*; 9.3%), and blue marlin (*Makaira nigricans*; 8.8%). Scombrids collectively comprised 45.0% of the total trolling catch.

FY 88 was marked by dramatic increases in the catches of all major species except blue marlin. The trolling catch was 104% higher than the catch of FY 87 and exceeded the historic high of FY85 by 34%. This sharp increase was due to a combination of increases in both participation and in CPUE. The number of boat trips increased by 63%, boat hours increased by 54%, and person-hours increased by 74%. CPUE increased by 33% to 6.0 kg/boat hour, exceeding the FY85 figure of 5.6 kg/boat-hour. Alternate measures of CPUE, kg/boat trip, and kg/person hour increased by 26% and 13%, respectively. This was due primarily to an excellent run of mahimahi which produced record landings of 146.2 m.t., 208% above the FY87 catch and 103% above the previous historic high of 72.0 m.t. Catches of skipjack tuna, yellowfin tuna, and wahoo increased by 202%, 59%, and 32%, respectively over those of FY87. The blue marlin catch decreased slightly (<6%)

* Refer to the appendix for a detailed report on the GIFD.

from the historical high catch of FY87. Landings of most minor species also increased, the most dramatic being that of rainbow runner (*Elagatis bipinnulatus* at 818%). However the barracuda (*Sphyraena barracuda*) and sailfish catches decreased by 45% and 33%, respectively.

Bottomfishing

An estimated 24.5 m.t. of bottomfish were landed island-wide during FY 88 (Table 3). Monthly catches ranged from a high of 4.4 m.t. in April to a low of 0.1 m.t. in February. The poorest catches occurred from December to March, and best catches were in November, April, and from July to September. An estimated 10,488 boat-hours were spent bottomfishing, resulting in an overall catch rate of 2.3 kg/boat-hour. Monthly catch rates ranged from 0.7 kg/boat-hour in March to 3.6 kg/boat-hour in October.

The estimated bottomfishing catch for FY 88 is 109% higher than that of FY 87, but all of this increase can be attributed to a more than doubling in participation. Boat trips, boat hours, and person hours increased by 100%, 111%, and 128%, respectively. The increase in participation did not seem to have had much effect on CPUE which leveled somewhat (a 3% drop in kg/boat hour from the FY 87 figure as opposed to a 14% drop over the previous two years). A large proportion of the increase in participation can be attributed to a renewed interest in deepwater (ca. 200 m) snappers.

Snappers (Lutjanidae) and Emperors (Lethrinidae) continued to dominate the Guam bottomfish catch, accounting for 33.8% and 24.2% of the weight landed, respectively (Table 4). The snapper catch increased dramatically over that of FY 87 (312%), due not only to a renewed interest in deepwater species, but also to higher catches of shallow species (a 227% increase). The most important snappers were uku (*Aprion virescens*; 1.5 m.t.), a shallow species that ranges into deeper water, followed by a number of deepwater species (ehu [*Etelis carbunculus*; 0.9 m.t.], opakapaka [*Pristipomoides filamentosus*; 0.8 m.t.], gindai [*P. zonatus*; 0.8 m.t.], lehi [*Aphareus rutilans*; 0.6 m.t.]), and the taape (*Lutjanus kasmira*; 0.6m. t.) another shallow species that ranges into deep water. The emperor catch increased 34% over the last year, once again dominated by the redgilled emperor (*Lethrinus rubrioperculatus*) which remained the single most important bottomfish species, comprising 20.4% (4.7 m.t.) of the overall bottomfishing catch and 84.5% of the emperor catch. Groupers (Serranidae; 13.1%) ranked third in importance with two species (*Epinephelus fasciatus* and *Variola louti*) dominating. Other important families included the jacks (Carangidae; 11.1%), requiem sharks (Carcharhinidae; 5.4%), tunas (Scombridae; 4.1%), squirrelfishes (Holocentridae; 3.3%), triggerfishes (Balistidae; 1.3%), and goatfishes (Mullidae; 1.2%) which were landed primarily at relatively shallow depths. Catches of sharks and triggerfishes may be underestimated because they are often considered undesirable and thrown back.

Spearfishing

The estimated monthly and annual participation, effort, and catch for spearfishing from boats during FY 88 is summarized in Tables 5 and 6. (Readers should also refer to Study F-1, Job 2 for estimates of spearing from shore, i.e., without the use of boats, to gain a more complete picture of FY 88 spearfishing activities on Guam.)

An estimated 12.2 m.t. of speared fish, crustaceans, and mollusks were landed from boats during FY 88. This represents an increase of 103% over the FY 87 catch, and 26% above the FY 85 historic high of 9.7 m.t. Most of this increase can be attributed to increases in participation of 105% and 80% in person-hours (5,103) and boat hours (2,105), respectively. The bulk of effort was by snorkeling rather than scuba diving (1,545 vs 560

boat hours). The average catch rate for spearfishing was approximately 5.8 kg/boat-hour, slightly higher (12%) than last years rate but lower (8%) than the 6.3 kg/boat hour for FY 85 and FY 86. Since some spearfishing parties return late at night outside our survey period and the GOES only considers complete interviews, we believe that the above estimates are low. Based on days in which participation in spearfishing occurred, but interviews were not obtained, it is believed that the GOES expansion for FY 87 underestimates the spearfishing catch by at least 26%.

As in previous years, parrotfishes (Scaridae; 39.3%) clearly dominated the FY 88 spearfishing catch (Table 7). Surgeonfishes (Acanthuridae; 21.9%), were second in importance, followed by wrasses (Labridae; 14.8%), rudderfishes (Kyphosidae; 6.0%), jacks (Carangidae; 5.6%), groupers (Serranidae; 4.2%), snappers (Lutjanidae; 3.4%), moray eels (Muraenidae; 3.4%), sharks (Carcharhinidae; 2.9%), squirrelfishes (Holocentridae; 2.8%), goatfishes (Mullidae; 2.2%), emperors (Lethrinidae; 1.7%), and sweetlips (Haemulidae; 1.4%). Bigeyes (Pristigasteridae), sweepers (Pomacentridae), butterflyfishes (Chaetodontidae), angelfishes (Pomacanthidae), and Rabbitfishes (Siganidae) collectively accounted for less than 1% of the spearfish catch. In addition to fishes, an estimated 1.6 m.t. (13.3%) of molluscs (primarily octopuses) and crustaceans (primarily spiny lobsters) were harvested by spearfishing parties during FY 88.

Atulai Night-Light Jigging

Changes in the sampling period and method of determining participation implemented in FY 85 made it possible to account for the bulk of offshore atulai fishing during the past four years.

Atulai (*Selar crumenophthalmus*) fishing was encountered during the months of November, June, August, and September, and at least one interview was obtained during each of these four months. An estimated 3.0 m.t. of atulai were landed by night-light jigging from boats during FY 88, representing a slight increase over the catch of FY 87, but way below (84%) the estimated 18.5 m.t. caught in FY 85. This continued low catch may have been due to continued decline in participation (766.3 vs 1,648 boat-hours in FY 87 compared with 3,707 boat-hours in FY 85) since CPUE rebounded (3.9 vs 1.6 kg/boat hour in FY 87 compared with 4.3 and 7.6 kg/boat-hour and FY 85 and 86, respectively) over the same time period. Based on days in which participation occurred, but interviews were not obtained, it is believed that the GOES underestimated the FY 88 atulai catch by this method by at least 25%.

Other Methods

Other rarely encountered methods during FY 88 included gill-netting, cast-netting, and by hand (the latter method may utilize a knife or hand tool or no equipment at all). Together, they produced an estimated catch of 0.6 m.t. during 246 boat-hours of effort. It is believed that the GOES underestimated the combined catch of these methods by about 14%.

Overview

Including the GIFD, an estimated 382.1 m.t. (90% confidence limit [CL] = 81.0 m.t.) of finfish (380.2 m.t.) and shellfish (1.9 m.t.) were landed island-wide by boats utilizing a variety of methods beyond the reef margin during FY 88. An estimated 15,305 boat trips were made in which 70,971 boat-hours were spent fishing. Excluding the GIFD, the average daily participation is estimated at 25.3 boats per weekday and 55.8 boats per weekend day or holiday. These figures represent increases of 77% and 39% above those for FY 87, respectively. Excluding the GIFD, overall monthly catch rates (kg/boat-hour)

ranged from 2.6 kg/boat-hour in December to 8.9 kg/boat-hour in March with an average of 5.0 kg/boat-hour. Trolling accounted for 89.4% of the FY 88 catch (341.7 m.t., 90% CL = 78.9 m.t.), bottomfishing comprised 6.4% of the catch (24.5 m.t.; 90% CL = 8.3 m.t.), spearfishing accounted for 3.2% (12.2 m.t.; 90% CL = 5.9 m.t.) of the catch, night-light jigging for atulai accounted for 0.8% of the catch (3.0 m.t.; 90% CL = 2.8 m.t.), and other rare methods accounted for the remaining 0.2% (0.8 m.t.) of the catch.

Catches for the three major fisheries (trolling, bottomfishing, and spearfishing) increased dramatically (all >100%) over the poor catches of the last two years. These increases can be attributed almost entirely to increases in participation for bottomfishing and spearfishing, but for the most important fishery, trolling, a significant rise in CPUE (33% for kg/boat hour) as well as participation (54% for boat hours) was also observed. This was due primarily to a large run of mahimahi. Although poor market conditions were cited as a contributing factor of the poor troll catch of FY 87, those same conditions appear to have worsened during FY 88. Ironically, catches of the least marketable species, skipjack tuna, tripled. Perhaps a number of key fisherman have found alternative markets to the Guam Fishermen's Cooperative, which usually markets the bulk of the catch.

CPUEs for bottomfishing and spearfishing which had been declining since FY 85, remained at approximately FY 87 levels while participation doubled. A renewed interest in deepwater snappers explains some of the increase in participation in bottomfishing. The continued, if not increasing importance of small species with high turnover rates at shallow to moderate depths (e.g. *Lethrinus rubrioperculatus* and *Epinephelus fasciatus*), is indicative of a heavily fished resource. However, relatively steady CPUEs indicate that the fishery is stable at current levels of participation. Unchecked increases in participation could be expected to result in significantly lower CPUEs and catches in the future. While good weather was undoubtedly a major factor, there is little doubt that Guam's current economic boom and rapid development are the major reasons for the dramatic increase in boating and fishing activity during FY 88.

RECOMMENDATIONS

There is little doubt that the reliability of estimates of island-wide catch and effort based on the present survey is limited by the quality of participation data taken at sites other than the Agana Boat Basin. We currently rely on the assumption that activity as well as catches landed at the Agana Boat Basin are representative of the island as a whole. This is not much better than an educated guess. We currently have no idea how much boating participation takes place from less accessible landings (e.g. the private Achang Bay Marina), nor do we have any data on the proportion of boating activity that is engaged in fishing from any site other than the Agana Boat Basin. Recent increases in staffing and manpower will enable us to take steps to obtain the necessary data beginning in FY 89. Beginning in October 1988, we initiated a once per month am and pm census of the Merizo Pier, alternating between weekends and weekdays. This will be extended to an additional monthly survey of the same design at the Agat Small Boat Harbor as soon as that facility opens. Both of these surveys will occur on the same days as the Agana Boat Basin survey. Further steps may be necessary in FY 90, depending on the results of the FY 89 survey. New information generated by the FY 89 and 90 surveys may require revisions of recent annual estimates of island-wide catch and effort.

Therefore, we recommend that this job continue and that sampling techniques continue to be refined or expanded as necessary. We also recommend that staff fisheries biologists continue to work closely with NMFS personnel in improving the efficiency and accuracy of

our computerized data analysis techniques, conduct a more detailed analysis of historical and current biological and survey data.

Report prepared by: Robert F. Myers

Table 1. Estimated monthly and annual trolling participation, effort, and catch during FY 88. Estimates include the GIFD. Weights are in kilograms (1 kg = 2.2 lbs).

A) PARTICIPATION:						
MONTH	NO. OF PERSONS	SE	90% CL	NO. OF BOAT-TRIPS	SE	90% CL
OCT	886.4	578.0	1,360.0	294.7	192.8	453.7
NOV	2,570.3	638.0	1,501.3	1,000.5	133.0	312.9
DEC	2,034.1	208.1	489.6	801.3	28.6	67.3
JAN	3,014.2	501.8	1,180.8	575.9	82.7	194.6
FEB	6,411.7	561.1	1,320.3	1,470.0	133.1	313.2
MAR	5,679.7	1,704.9	4,011.6	1,515.8	483.9	1,138.7
APR	4,117.4	76.7	180.4	1,157.6	70.6	166.0
MAY	3,021.5	742.4	1,746.9	938.1	221.2	520.4
JUN	2,764.9	442.8	1,042.0	699.6	125.0	294.2
JUL	3,891.2	113.7	267.5	1,143.5	53.6	126.0
AUG	4,619.1	747.8	1,759.1	1,326.1	172.2	405.2
SEP	2,364.0	638.6	1,502.6	692.8	205.9	484.5
TOTAL	41,374.5			11,615.9		
GOES	41,522.6	3,282.6	5,527.9	11,678.9	817.9	1,377.4
B) EFFORT:						
MONTH	NO. OF PERSON-HOURS	SE	90% CL	NO. OF BOAT-HOURS	SE	90% CL
OCT	4,235.8	2,900.2	6,824.2	1,402.0	998.1	2,348.6
NOV	14,238.3	2,065.1	4,859.3	5,707.2	499.5	1,175.2
DEC	10,271.9	1,082.5	2,547.2	4,080.2	221.3	520.8
JAN	13,555.7	337.8	794.8	2,664.5	286.7	674.6
FEB	27,264.5	1,613.5	3,796.5	6,318.9	386.6	909.8
MAR	30,384.2	9,214.2	21,681.0	8,119.7	2,610.4	6,142.3
APR	22,367.4	2,220.8	5,225.5	6,249.4	405.4	953.8
MAY	14,879.9	4,477.4	10,535.3	4,690.7	1,370.9	3,225.6
JUN	10,535.1	2,155.6	5,072.2	2,658.2	621.8	1,463.1
JUL	18,027.9	433.0	1,018.9	5,325.7	354.5	834.2
AUG	21,490.0	3,212.3	7,558.5	6,193.7	779.8	1,834.8
SEP	12,523.7	3,247.6	7,641.6	3,692.7	1,099.1	2,586.1
TOTAL	199,774.4			57,102.9		
GOES	200,276.1	15,691.3	26,424.1	57,364.9	4,220.7	7,107.6
C) CATCH:						
MONTH	NO. OF KILOGRAMS	SE	90% CL	Kg/B-T	Kg/B-H	Kg/P-H
OCT	7,132.5	5,844.8	13,752.9	24.2	5.1	1.7
NOV	15,963.7	904.5	2,128.3	16.0	2.8	1.1
DEC	10,073.4	1,591.0	3,743.5	12.6	2.5	1.0
JAN	5,773.3	2,404.9	5,658.8	10.0	2.2	0.4
FEB	38,681.5	5,335.8	12,555.2	26.3	6.1	1.4
MAR	77,539.1	23,646.4	55,640.0	51.2	9.5	2.6
APR	47,159.9	4,293.1	10,101.7	40.7	7.5	2.1
MAY	32,599.5	17,329.8	40,776.9	34.8	6.9	2.2
JUN	14,310.1	5,746.5	13,521.5	20.5	5.4	1.4
JUL	41,060.2	11,417.6	26,865.7	35.9	7.7	2.3
AUG	36,249.2	13,114.8	30,859.2	27.3	5.9	1.7
SEP	14,663.9	4,202.3	9,888.0	21.2	4.0	1.2
TOTAL	341,206.3			29.4	6.0	1.7
GOES	341,724.5	46,849.2	78,894.1	29.3	6.0	1.7

Table 2. Monthly and annual composition of the Guam trolling catch during FY 88. Estimated weights are in kilograms and include the GHFD. A + indicates less than 0.05% of the annual catch.

FAMILY and SPECIES	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	FY 88	% of total
<i>Carcharhinidae</i>														
<i>Carcharhinus amblyrhynchus</i>		265.5							1,047.5				265.5	<0.1
<i>C. falciformis</i>						692.2							1,047.5	0.3
Und. sp.													767.9	0.2
<i>Belonidae</i>														
<i>Ablestes hians</i>			31.2	28.7									59.9	+
<i>Carangidae</i>														
<i>Carangoides orthogrammus</i>			6.2					9.2	6.4	69.2	16.2		107.2	+
<i>Caranx melampygus</i>								71.1	33.3	7.6	51.4		163.4	+
<i>C. papuensis</i>								23.7		64.1	18.1		105.9	+
<i>Elaeatis bipinnatus</i>	19.0		162.2		57.8	306.9	218.6	192.1	402.0	1,890.6	635.5	98.2	3,982.9	1.2
<i>Scomberoides lysan</i>							71.9		3.8				3.8	+
Und. sp.													71.9	+
<i>Coryphaenidae</i>														
<i>Coryphaena hippurus</i>		1,297.5	2,815.5	3,979.1	31,785.8	68,257.9	27,862.5	10,003.5	107.2	22.5	57.4		146,188.9	42.8
<i>Lujiatidae</i>														
<i>Aplikareus jurca</i>						40.0		6.3	27.4		14.2		87.9	+
<i>Aplon virescens</i>											46.3		46.3	+
<i>Syngnathidae</i>														
<i>Syngnathus barracuda</i>	124.8	371.7	246.5		112.5	91.4	327.1	310.7	82.5	43.5	410.3		2,122.0	0.6
<i>S. geniv</i>					258.7			298.8					557.5	0.2
<i>Scombridae</i>														
<i>Acanthocybium solandri</i>	2,928.4	11,341.2	4,171.0	498.1	1,339.9	972.9	6,412.9	2,710.8	2,119.8	2,189.5	1,494.0	2,171.9	38,350.4	11.2
<i>Ausis thazard</i>										6.4			6.4	+
<i>Euthynnus affinis</i>	117.7	83.0	74.9	36.7	281.2	217.7	188.7	66.4	13.2	492.6	44.9	25.6	1,524.9	0.4
<i>Gymnosarda unicolor</i>	2,216.2	526.0	198.1		254.7	386.4	7,622.6	9,593.2	560.9	434.7	22.8		2,501.3	0.7
<i>Katsuwonus pelamis</i>	501.7	1,164.7	666.1	308.1	2,045.3	5,070.4	9,113.0	3,725.8	4,153.8	17,557.8	20,788.0	8,146.8	79,353.0	23.3
<i>Thunnus albacares</i>		449.6	1,329.0	233.1	2,085.4	982.0	3,113.0		2,047.2	8,596.5	5,133.9	3,615.8	31,813.0	9.3
<i>Istiophoridae</i>														
<i>Istiophorus platypterus</i>	392.4		273.0		441.8								1,107.2	0.3
<i>Makaira nigricans</i>	832.3	464.6		689.4									29,966.5	8.8
<i>Tetrapturus angustirostris</i>			99.8		273.1	653.0	956.2	5,587.6	3,705.1	9,609.6	7,516.1	605.6	1,030.0	0.3
Total	7,132.5	15,963.7	10,073.4	5,773.3	38,681.5	77,539.1	47,159.9	32,599.5	14,310.1	41,060.2	36,249.2	14,663.9	341,206.3	100.0

Table 3. Estimated monthly and annual Guam bottomfishing participation, effort, and catch during FY 88. See text for explanation.

A) PARTICIPATION:						
MONTH	NO. OF PERSONS	SE	90% CL	NO. OF BOAT-TRIPS	SE	90% CL
OCT	267.6	177.1	416.7	133.8	88.5	208.3
NOV	542.4	256.4	603.3	232.0	106.7	251.0
DEC	213.4	65.0	152.9	81.4	24.3	57.3
JAN	47.2	33.4	78.6	24.5	16.2	38.1
FEB	79.1	69.8	164.1	35.2	31.0	73.0
MAR	195.6	81.8	192.5	73.3	26.1	61.4
APR	900.8	164.6	387.4	375.0	87.7	206.3
MAY	713.0	87.0	204.7	242.1	53.3	125.4
JUN	590.6	143.6	337.9	218.5	61.2	143.9
JUL	1,363.2	100.1	235.5	518.8	53.7	126.3
AUG*	1,260.7	417.8	983.2	283.4	81.4	191.4
SEP	886.8	357.1	840.2	275.4	108.1	254.4
TOTAL	7,060.4			2,493.4		
GOES**	7,198.1	990.6	1,668.2	2,543.1	313.0	527.0
B) EFFORT:						
MONTH	NO. OF PERSON-HOURS	SE	90% CL	NO. OF BOAT-HOURS	SE	90% CL
OCT	1,071.8	698.9	1,644.4	535.9	349.4	822.2
NOV	3,183.5	1,539.4	3,622.1	1,443.7	759.1	1,786.1
DEC	513.3	75.9	178.5	205.9	33.2	78.2
JAN	147.1	97.2	228.8	101.8	77.7	182.8
FEB	197.8	174.4	410.4	87.9	77.5	182.4
MAR	600.9	288.1	677.8	219.9	87.0	204.8
APR	3,972.0	1,535.0	3,611.8	1,602.4	641.1	1,508.5
MAY	2,946.8	267.4	629.1	1,108.8	348.7	820.5
JUN	1,811.3	332.2	781.6	660.9	138.2	325.2
JUL	5,915.3	749.5	1,763.6	2,270.4	470.9	1,108.1
AUG	3,556.2	1,285.1	3,023.7	979.5	421.5	991.9
SEP	3,355.0	1,503.6	3,538.1	1,033.5	444.0	1,044.7
TOTAL	27,271.0			10,250.6		
GOES	28,023.7	4,219.3	7,105.2	10,488.3	1,619.8	2,727.8
C) CATCH:						
MONTH	NO. OF KILOGRAMS	SE	90% CL	Kg/B-T	Kg/B-H	Kg/P-H
OCT	1,947.5	1,324.8	3,117.3	14.6	3.6	1.8
NOV	3,131.5	1,913.4	4,502.1	13.5	2.2	1.0
DEC	280.6	14.3	33.6	3.4	1.4	0.5
JAN	164.6	108.1	254.5	6.7	1.6	1.1
FEB	105.2	92.8	218.3	3.0	1.2	0.5
MAR	161.4	100.1	235.6	2.2	0.7	0.3
APR	4,398.1	1,707.8	4,018.6	11.7	2.7	1.1
MAY	1,665.9	476.8	1,121.9	6.9	1.5	0.6
JUN	1,747.4	665.3	1,565.4	8.0	2.6	1.0
JUL	3,577.5	857.3	2,017.2	6.9	1.6	0.6
AUG	3,366.7	2,091.4	4,920.9	11.9	3.4	0.9
SEP	2,545.6	1,299.9	3,058.6	9.2	2.5	0.8
TOTAL	23,092.0			9.3	2.3	0.8
GOES	24,458.2	4,905.3	8,260.5	9.6	2.3	0.9

* Results are based on a 28 day expansion on the assumption that bottomfishing was negligible during the three day GIFD.

** Results are based on a 363 day expansion based on the assumption that bottomfishing was negligible during the three day GIFD.

Table 4. Composition of the Guam bottomfishing catch during FY 88. Estimated weights are in kilograms. Percentages are based on the differentiated portion of the catch only. The data is based on a 363 day expansion which assumes that there was no bottomfishing activity during the three day GIFD.

FAMILY	WEGHT (Kg)	%
Carcharhinidae (Requiem sharks)	1,246.4	5.4
Holocentridae (Squirrelfishes)	758.2	3.3
Serranidae (Groupers)	3,007.6	13.1
Carangidae (Jack)	2,625.0	11.1
Lutjanidae (Snappers)	7,747.3	33.8
Lethrinidae (Emperors)	5,545.0	24.2
Mullidae (Goatfishes)	282.3	1.2
Sphyraenidae (Barracudas)	124.2	0.5
Labridae (Wrasses)	179.6	0.8
Scombridae (Tunas)	951.1	4.1
Balistidae (Triggerfishes)	301.4	1.3
*Others	110.3	0.5
SUBTOTAL	22,937.1	100.0
Undifferentiated	1,521.1	
TOTAL	24,458.2	

* Includes Muraenidae, Synodontidae, Scorpaenidae, Cirrhitidae, Apogonidae, Priacanthidae, Malacanthidae, Haemulidae, Pempheridae, Acanthuridae, and Triodontidae, each of which comprised less than 0.1% of the catch.

Table 5. Estimated monthly and annual offshore spearfishing (with and without scuba) participation, effort, and catch during FY 88.

MONTH	PARTICIPATION		EFFORT		CATCH no. of Kilograms	Kg/ boat trip	Kg/ pers.-hr	Kg/ boat-hr
	no. of Persons	no. of Boat trips	no. of Person-hrs	no. of Boat-hrs				
OCT	33.5	32.6	175.4	175.4	662.0	20.3	3.8	3.8
NOV	146.3	74.6	375.3	196	511.0	6.9	2.6	2.6
DEC	55.5	31.7	118.9	71.2	771.3	24.3	10.8	10.8
JAN	23.8	11.9	47.5	23.8	949.2	79.8	39.9	39.9
FEB	no sample (activity negligible)							
MAR	34.9	34.9	39.3	39.3	79.3	2.3	2.0	2.0
APR	62.4	41.6	76.0	64.1	241.1	5.8	3.8	3.8
MAY	417.4	167.1	1,265.2	493.3	2,460.9	14.7	5.0	5.0
JUN	268.6	125.2	389.9	170.1	689.2	5.5	4.1	4.1
JUL	365	129.5	722.4	254.4	1,115.9	8.6	4.4	4.4
AUG*	585.9	187.7	1,564.8	510.0	3,753.8	20.0	7.4	7.4
SEP	146.3	44.9	253.3	78.7	415.7	9.3	5.3	5.3
TOTAL	2,139.6	881.7	5,028.0	2,076.3	11,649.4	13.2	5.6	5.6
GOES**	2,222.4	898.8	5,103.3	2,105.4	12,168.0	13.5	2.4	5.8

* Results are based on a 31 day expansion supported by observations indicating that bottomfishing was unaffected by the three day GIFD.

** Results are based on a 366 day expansion supported by observations indicating that bottomfishing was unaffected by the three day GIFD.

Table 6. Estimated annual Guam offshore spearfishing participation, effort, and catch by method during FY 88.

A) PARTICIPATION:		No. of Persons	SE	90% CL	No. of Boat trips	SE	90% CL
Snorkel		1,551.4	334.4	563.1	577.3	107.6	181.1
Scuba		671.0	215.1	362.3	321.5	84.2	141.7
Total Spearfishing		2,222.4			898.8		
B) EFFORT:		Person- hours	SE	90% CL	Boat- hours	SE	90% CL
Snorkel		4,097.4	1,054.0	1,774.9	1,545.3	356.6	600.5
Scuba		1,005.9	281.9	474.7	560.1	143.6	241.8
Total Spearfishing		5,103.3			2,105.4		
C) CATCH:		No. of Kilograms	SE	90% CL	Kg/ boat trip	Kg/ pers.-hr.	Kg/ boat-hr
Snorkel		8,544.3	2,280.5	3,840.3	14.8	5.5	2.1
Scuba		3,623.7	1,201.3	2,022.9	11.3	6.5	3.6
Total Spearfishing		12,168.0			13.5	5.8	2.4

Table 7. Composition of the Guam spearfishing catch during FY 88. Percentages of finfish are of the differentiated portion of the finfish catch only.

FAMILY	SNORKEL		SCUBA		TOTAL	
	(Kg)	%	(Kg)	%	(Kg)	%
Orectolobidae (Nurse sharks)	355.7	5.8	-	-	355.7	2.9
Muraenidae (Moray eels)	168.1	2.7	133.8	4.8	301.9	3.4
Holocentridae (Squirrelfishes)	113.4	1.85	132.9	4.8	246.3	2.8
Serranidae (Groupers)	147.5	2.4	232.2	8.3	379.7	4.2
Priacanthidae (Bigeyes)	2.7	≤0.05	-	-	2.7	≤0.05
Carangidae (Jacks)	484.9	7.9	16.4	0.6	501.3	5.6
Lutjanidae (Snappers)	219.1	3.6	84.3	3.0	303.4	3.4
Haemulidae (Sweetlips)	79.2	1.3	48.0	1.7	127.2	1.4
Lethrinidae (Emperors)	102.6	1.7	51.8	1.9	154.4	1.7
Mullidae (Goatfishes)	90.0	1.4	105.8	26.3	195.8	2.2
Pempheridae (Sweepers)	-	-	2.2	0.1	2.2	≤0.05
Kyphosidae (Rudderfishes)	501.3	8.2	33.8	1.2	535.1	6.0
Chaetodontidae (Butterflyfishes)	1.1	≤0.05	-	-	1.1	≤0.05
Pomacanthidae (Angelfishes)	1.6	≤0.05	-	-	1.6	≤0.05
Labridae (Wrasses)	310.2	5.1	290.1	10.4	600.3	14.8
Scaridae (Parrotfishes)	2,308.5	37.7	1,197.5	43.0	3,506.0	39.3
Acanthuridae (Surgeonfishes)	1,528.9	25.0	424.7	15.2	1,953.6	21.9
Siganidae (Rabbitfishes)	12.3	0.2	33.9	1.2	46.2	0.5
Subtotal	6,123.8	71.7	2,787.5	76.9	8,911.3	73.2
Undifferentiated Fishes	880.8	10.3	755.1	20.8	1,635.9	13.4
TOTAL (Finfishes)	7,004.6	82.0	3,542.6	97.8	10,547.2	86.7
Gastropods	829.2	9.7	-	-	829.2	6.8
Octopuses & Squids	25.3	0.3	60.9	2.2	86.2	0.7
Crabs	61.0	0.7	-	-	61.0	0.5
Spiny Lobsters	303.0	3.5	16.9	0.5	319.9	2.6
Slipper Lobsters	321.2	3.8	3.3	0.1	324.5	2.7
Invertebrate Subtotal	1,539.7	18.0	81.1	2.2	1,620.8	13.3
TOTAL	8,544.3	70.2	3,623.7	29.8	12,168.0	100.0

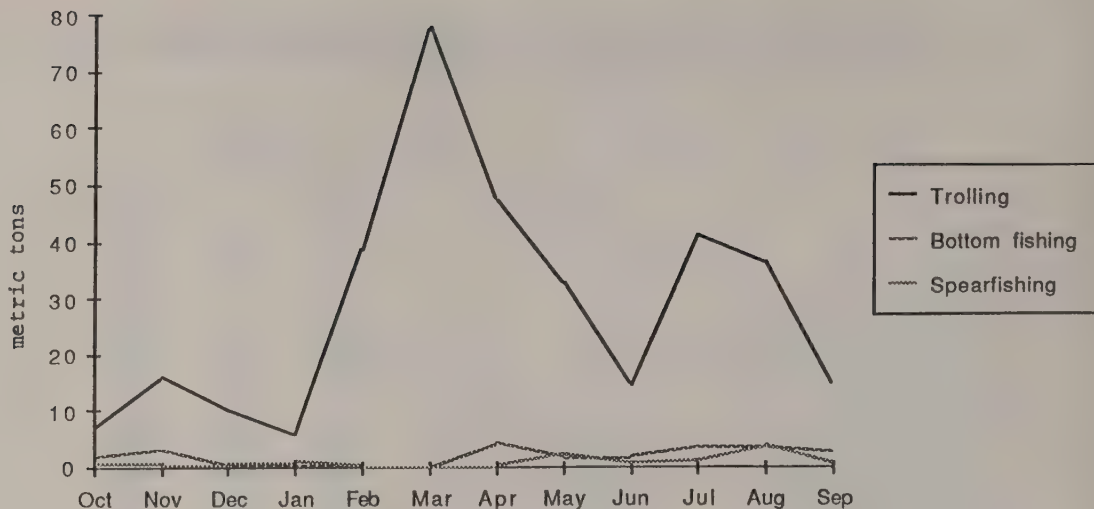


Figure 1. Monthly fluctuations in the estimated Guam offshore fish landings during FY 88. For August, the troll catch is based on a 28 day expansion plus the GIFD landings, the bottomfish catch is based on 28 day expansion that assumes negligible activity during the GIFD, and the spearfishing catch is based on a 31 day expansion.

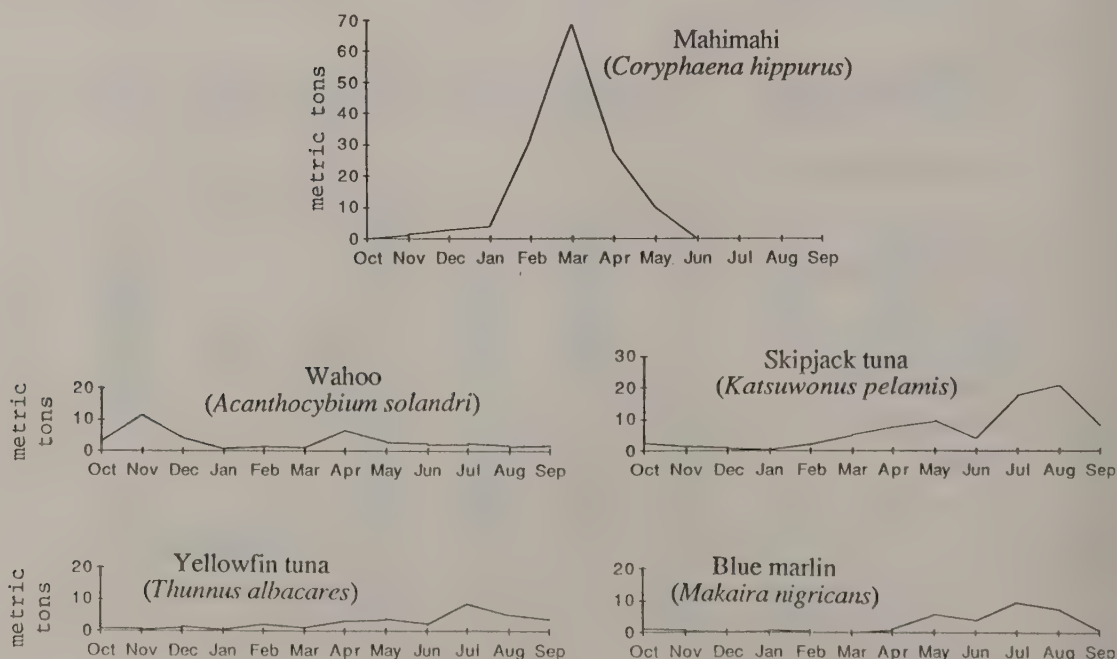


Figure 2. Monthly fluctuations in the estimated landings of Guam's major troll-caught species during FY 88. August figures include the GIFD.

boat trips) occurred to the north of the Agana Boat Basin. The higher overall catch reported from the north was due entirely to blue marlin, most of which were caught along Guam's northwest coast. However, the higher number of marlin caught in the north was attributable only to the much greater effort expended there. The bulk of the yellowfin tuna and wahoo were caught in the south, almost exclusively at the southern banks. Catch rates for all derby species were higher in the south. Blue marlin appeared to be equally, if not more likely, caught along Guam's shoreline than at offshore banks. Yellowfin tuna and wahoo were most likely to be caught at southern banks. These results are consistent with the more limited results of the past two years' GIFDs in which a much greater effort spent in the north resulted in a greater overall catch from the north, but the highest catch rates were in the south.

ACKNOWLEDGEMENTS

The fisheries biologists from the Division of Aquatic & Wildlife Resources (DAWR) wish to thank the Guam Fishermen's Cooperative, as well as the competing anglers for their cooperation and assistance in providing the catch information that made this report possible. This cooperation not only makes our job easier and more enjoyable, but insures a more accurate collection of data.

Report prepared by Robert F. Myers

Table 1. Daily participation, effort and catch in the twelfth annual Guam International Fishing Derby. Weights are expressed in kilograms (1kg=2.2 lbs).

	DAY 1 AUG 19	DAY 2 AUG 20	DAY 3 AUG 21	DERBY TOTALS
Number of boat trips	95	96	72	263
Number of fishermen	292	311	230	833
Ave. number of persons per boat	3.1	3.2	3.2	3.2
Number of lines fished	432	412	298	1142
Ave. number of lines per boat	4.5	4.3	4.1	4.3
Boat hours	894.0	818.9	571.7	2,275.0
Fished hours	862.6	774.7	519.1	2,161.9
Ave. boat trip length	9.4	8.5	7.9	8.7
Ave. time spent fishing	9.1	8.1	7.2	8.2
Fishermen hours	2,747.7	2,652.8	1,826.2	7,205.5
Line hours	3,922.6	3,324.8	2,148.6	9,387.2
No. fish landed	579	280	134	993
Catch landed (Kg)*	4,009.1	2,845.3	1,334	8,188.4
Kg/boat	42.2	29.6	18.5	31.1
Kg/boat hour	4.48	3.47	2.33	3.60
Kg/man hour	1.46	1.07	0.73	1.14
Kg/line hour	1.02	0.86	0.62	0.87

* Includes incidental catch.

Table 2. Daily catch composition for the twelfth annual Guam International Fishing Derby. Weights are expressed in kilograms (1 kg=2.2 lbs).

	DAY 1 - AUG 19			DAY 2 - AUG 20			DAY 3 - AUG 21			TOTAL		
	NUMBER CAUGHT	TOTAL WT.	AVE WT.	NUMBER CAUGHT	TOTAL WT.	AVE WT.	NUMBER CAUGHT	TOTAL WT.	AVE WT.	NUMBER CAUGHT	TOTAL WT.	AVE WT.
Blue marlin	23	1,507.3	65.5	24	1,566.8	65.3	11	758.0	68.9	58	3,832.0	66.1
Yellowfin tuna	114	610.2	5.4	28	143.0	5.1	19	95.4	5.0	161	848.5	5.3
Wahoo	32	270.0	8.4	25	175.4	7.0	15	122.0	8.1	72	567.3	7.9
Mahimahi	3	4.5	1.5	1	4.3	4.3	1	3.4	3.4	5	12.2	2.4
Skipjack tuna	347	1,487.0	4.3	162	845.2	5.2	75	331.1	4.4	584	2,663.4	4.6
Rainbow runner	40	74.8	1.9	17	27.5	1.6	6	8.8	1.5	63	111.1	1.8
Barracuda	9	38.9	4.3	17	74.2	4.4	3	10.2	3.4	29	123.3	4.3
Kawakawa	8	5.1	0.6	3	0.7	0.2	4	5.2	1.3	15	11.0	0.7
Dogtooth tuna	3	11.4	3.8	3	8.2	2.7	0	0.0	-	6	19.6	3.3
TOTALS	579	4,009.1	6.9	280	2,845.3	10.2	134	1,334.0	10.0	993	8,188.4	8.2

Table 3. Catch comparison for all Guam International or Marianas Fishing Derbies¹. Weights are expressed in kilograms (1 kg=2.2 lbs).

	1977	1978	1979	1980	1981	1982	1983	1984 ²	1985	1986	1987	1988
MARLIN												
no. caught	9	9	6	12	34	12	13	47	17	47	43	58
total weight	933.0	511.0	703.0	727.0	2,005.0	852.0	964.1	2,840.4	1,659.7	2,859.1	4,008.3	3,832.0
ave. weight	103.6	56.8	117.2	60.6	59.0	71.0	74.2	60.4	97.6	60.8	93.2	66.1
winning fish	192.0	75.2	328.0	139.0	145.0	132.0	199.1	215.4	178.0	173.9	188.0	155.3
YELLOWFIN												
no. caught	18 ³	11	34	50	109	205	100	59	137	71	116	161
total weight	240.0	255.0	637.0	308.0	1,156.0	2,377.0	1,105.7	388.8	1,058.2	406.0	858.4	848.5
ave. weight	13.3	23.2	18.7	6.2	10.6	11.6	11.1	6.6	7.7	5.7	7.4	5.3
winning fish	46.3	56.8	67.7	51.1	47.7	61.1	55.7	51.7	45.9	46.0	26.8	44.9
WAHOO												
no. caught	7	9	11	12	33	60	36	46	98	16	31	72
total weight	90.9	102.0	116.0	161.0	543.0	264.0	359.7	466.1	921.6	136.7	314.2	567.4
ave. weight	13.0	11.4	10.5	13.4	16.5	4.4	10.0	10.1	9.4	8.5	10.1	7.9
winning fish	22.3	18.9	19.7	23.4	17.0	22.7	24.5	21.3	23.5	17.7	16.7	22.4
MAHIMAH												
no. caught	2	4	5	3	1	14	33	0	14	7	3	5
total weight	13.6	26.4	52.6	39.3	0.8	63.7	195.2	-	76.6	61.5	40.1	12.2
ave. weight	6.8	6.6	10.5	13.1	-	4.6	5.9	-	5.5	8.8	13.4	2.4
winning fish	8.9	8.9	14.8	15.9	0.8	14.8	11.1	-	14.8	14.7	15.6	4.3
DERBY SPECIES CATCH												
no. caught	36	33	56	77	177	291	182	152	266	141	193	296
total weight	1,277.5	894.4	1,508.6	1,235.3	3,704.8	3,556.7	2,624.7	3,695.3	2,716.1	3,463.3	5,221.0	5,260.1
most fish per boat	-	-	-	-	-	-	-	-	-	-	57	42
TOTAL CATCH												
no. caught	-	-	-	-	-	-	281	336	427	237	488	993
total weight	-	-	-	-	-	-	3,277.6	4,365.2	4,370.2	3,794.0	6,668.3	8,188.4

¹Based on returned catch reports for 1977 to 1983, but includes estimated bicatch and unreported catches for 1984 to present. Only the principal derby species are reported for 1977 to 1982.

²Based on known catches of principle derby species and estimated catches of non-derby species expanded for non-reporting boats.

³Includes all tuna species.

Table 4. Effort, catch, and catch rates by area for the twelfth annual GIFFD. Effort is based on the number of boat trips in which area fished was reported. Effort reported as both "north and south" was divided equally into north and south.

Area	Effort (number of boat trips)	Catch		Catch rate (kg./trip)									
		Blue marlin no. kg.	Yellowfin tuna no. kg.	Wahoo no. kg.	Blue marlin no. kg.	Yellowfin tuna no. kg.	Wahoo no. kg.						
North	116	34	2,381.7	39	291.6	24	183.2	0.3	20.5	0.3	2.5	0.2	1.6
NW coast only	63	23	1,818.0	3	83.7	9	89.0	0.4	28.9	<0.1	1.3	0.1	1.4
Including banks	33.5	9	465.1	32	192.1	9	55.3	0.3	13.9	1.0	5.7	0.3	1.7
Not including banks	7	2	98.6	4	14.3	4	28.0	0.3	14.1	0.6	2.0	0.6	4.0
unspecified	12.5					2	10.9					0.2	0.9
South	41	19	1,215.4	87	391.4	31	236.1	0.5	29.6	2.1	9.5	0.8	5.8
Including banks	26	16	977.3	86	360.8	30	226.1	0.6	37.6	3.3	13.9	1.2	8.7
Not including banks	4.5	3	238.1	1	30.6	1	10.0	0.7	52.9	0.2	6.8	0.2	2.2
unspecified	10.5												

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-25

SUB-PROJECT NO.: F

STUDY NO.: F-1

JOB NO.: 2

JOB TITLE: Inshore Fisheries Survey

PERIOD COVERED: October 1, 1987 to September 30, 1988.

SUMMARY

Monthly inshore fisheries surveys were conducted along Guam's shoreline from October, 1987 to September, 1988. The total estimated inshore fisheries catch for this time period was 160.9¹ m.t., 92.9% of which were finfish. Hook and line fishing was the most popular method accounting for 56.8% of the total participation, which yielded 26.1 m.t., more than any other single method. Drag netting was the most successful method in terms of catch rate, yielding approximately 3.2 Kg/gear-hour. The months of May and June of FY 88 yielded an extraordinary 29 m.t. of juvenile rabbitfish (manahac).

BACKGROUND

Effective management of Guam's inshore fishery resources requires accumulating data on the types of fishing methods used, fishing pressure, and annual catch. In order to identify trends in fishing participation, effort, and catch, the Division of Aquatic and Wildlife Resources (DAWR) has been monitoring marine fishing activities since the early 1960's. Over this period of time, survey and analysis methodologies have changed in response to fluctuations in budget and staff. In the last several years, however, field survey techniques have been expanded and refined, while estimates of Guam's recreational/subsistence fishing activities have come to be based on more reliable data analysis techniques.

OBJECTIVES

1. To estimate the total annual inshore participation, effort and harvest of Guam's inshore recreational/subsistence fisheries through statistically valid surveys and analysis.
2. To gather limited biological data that will add to a long-term historical data base on Guam's important inshore fish species.

¹ This value includes the 27 m.t. of *Selar crumenophthalmus* (Atulai) caught seasonally

PROCEDURES

During FY 88, day and night "inshore participation" surveys were conducted on four randomly selected days per month. These surveys entailed making visual observations of not only participation among the various fishing methods employed, but also of the reef zones and general locations that were fished within the more readily accessible portions of Guam's coastline (Fig. 1, locations 1-72). Based on data collected during nine non-consecutive years of aerial surveys conducted between FY 63 and FY 79, approximately 85% of Guam's inshore fishing activities is known to occur within this area. The starting location for each survey was selected at random and the "circular" direction of driving was alternated between surveys. Observations were made while driving the route once without backtracking. These methods were applied for both day and night participation surveys.

In addition, four "inshore-catch" survey days were selected. During these catch days, a fisherman-intercept survey was conducted to gather catch, effort, and species composition data for both day and night fishing. The day survey covered a six-hour interval (starting at 0630 hours) and the night survey covered a five-hour interval (starting at 1900 hours). Only one of three survey regions (Fig. 1) was selected for each "inshore-catch" day and fisheries data collection was restricted to that region. However, because of infrequently used methods (i.e., drag net and surround net), representative samples were sometimes difficult to obtain. Therefore, if an area could not provide a required fishing method survey, one of the other two areas could be searched.

The FY 88 inshore harvest estimates were calculated by a computer software package known as the Guam Inshore Expansion System (GIES). The GIES utilizes formulae described in FY 85 project report (Project No. FW-2R-22, Sub-Project F, Study No. F-1, Job No. 2).

RESULTS

During FY 88, the estimated inshore harvest for day, night, and seasonal fishing around Guam was 160.9 m.t.. Finfish accounted for 92.9% of the total harvest, or 149.5 m.t.. The finfish catch resulted from a total effort of 219,486.9 person-hours and 192,435.6 gear-hours². Overall, approximately 0.63 and 0.74 Kg of fish were taken per person-hour and gear-hour, respectively. Estimated participation, effort, and catch values for each fishing method are shown in Table 1. The values in Table 1 are combined estimates of separate expansions of day, night, and seasonal catch data collections. Tables 2 and 3 present the participation, effort, and catch for day and night fishing for each method.

Hook and line fishing was, by far, the most popular method, accounting for approximately 56.8% of the total participation. Also, this method yielded the highest estimated catch of 26.1 m.t. or 19.5% of the total inshore catch. The catch rate for hook and line was 0.20 Kg/gear-hour.

Spearfishing with snorkel gear yielded the largest harvest for night fishing, at 11,198.3 Kg (Table 3), which accounted for only 7.5% of the total catch (total catch refers to combined day and night catch). The mean catch rate for this method was 0.88 Kg/gear-hour. Separate spearfishing harvests were also recorded in the offshore fisheries survey and the expanded harvest and participation for that information is reported in Project No. FW-2R-25, Sub-Project F, Study No. F-1, Job No. 1 of FY 88

Various net fishing methods also contributed to the annual catch estimates. Gill netting was the most popular and most successful net fishing method with 8,251 participants (13.6% of the total)

²The effort values do not include estimated values for mackerel due to the variability of the effort in this fishery.

and produced 25.8 m.t. giving a catch rate of 1.51 Kg/gear-hour. Cast netting represented the second most popular net method with an estimated 6,016 participants and yielded 14,604.9 Kg. Surround netting yielded a surprisingly low mean catch rate in comparison to past years at 2.0 Kg/gear-hour and produced only 3,024.5 Kg of fish. Drag netting also contributed to the estimated catch by yielding approximately 3,810.3 Kg at 3.2 Kg/gear-hour, all being caught at night (See Table 3).

The species composition for the FY 88 expanded harvest for day, night, and combined are presented in Tables 4, 5, and 6. The day species composition substantiated the exceptional seasonal fisheries harvest that occurred during FY 88. The top two species harvested during day fishing, *Selar crumenophthalmus* and *Siganus argenteus* are both seasonal fisheries. The harvest and effort information for these fisheries were determined independently from the GIES system due to the sporadic nature of these fisheries. In the past, the top day-caught species has been *Naso unicornis*, but during FY 88 this fish ranked third. The top night-caught species was *Naso unicornis* as in previous years. The family Scaridae unexpectedly failed to rank among the top ten families caught at night. The exact cause of this change is unknown at this time but worthy of further investigation. The scarids are typically a major contributor to the night harvests. The combined day and night harvest represent basically the same order as that of day due to the magnitude of day vs. night harvests.

The seasonal catch of certain juvenile fishes is widely anticipated by local fishers. The FY 88 catch was marked by seasonal harvests of juvenile goatfish (tiao) during May through September; and juvenile rabbitfish (manahac) during May and June; and juvenile jacks (e'e') primarily during July and August. In addition, the catch of atulai (*Selar crumenophthalmus*) occurred from January to August.

The catches of tiao and e'e' are fairly well represented within the expansion estimates given in Tables 1-3. However, the catches of manahac and atulai are not well represented due to the highly sporadic nature of these fisheries which are easily missed by randomly scheduled surveys. Making accurate estimates for such catches requires intensive survey effort during the periods in which these fish are exploited. The seasonal occurrence of recruiting juvenile *Siganus spinus* and *S. argenteus* results in intense fishing over a very short period of time. The effort and catch for this fishery is therefore determined separately from the rest of the fiscal year methods. Cast nets and seines were used to catch an unusually high 29.0 m.t. of juvenile rabbitfish during FY 88. This large harvest of juvenile rabbitfish accounts for a major part of the increased total harvest in FY 88 over FY 87. The manahac fishery contributed 81.7% of the rabbitfish harvest, which was the single largest family harvested, yielding 35,515.6 Kg. Tables 7 contains participation and harvest estimates for the May and June rabbitfish runs.

Atulai (*Selar crumenophthalmus*) or mackerel fishing as it is commonly referred to on Guam, is separated from the other nine methods that are surveyed and expanded during the fiscal year. The sporadic nature of atulai fishing requires a separate analysis from the participation data collected during regular participation surveys. The length of the season was determined by the first atulai participation record and the last. The fishable number of days during that period was determined by the ratio of participated days to the number of survey days each month. This ratio was applied to the number of days in each month within the determined season. The number of fishable days was then multiplied by the average catch rate to determine the catch. This method was applied only to net fishing (surround netting or gill netting in bays, channels, and harbors upon site of a school) for atulai because catch estimates by hook and line are included in the annual estimates. The behavior of this fish is unlike other reef fish encountered on the inshore survey; they school in channels, bay, and harbors, and are caught in both inshore and offshore locations in large numbers (harvest estimates for the offshore harvest are presented in Project No. FW-2R-25, Sub-Project F, Study No. F-1, Job No. 1 of FY 88). The fact that the methodology of harvesting these fish is different than any other inshore fishery, and that they are so behaviorally different warrants their

separation for expansion and analysis. The estimated catch of atulai by nets was 27 m.t. for FY 88. Due to the limitations in collecting participation data for this highly sporadic fishery, the participation was not incorporated into the total island value. If the atulai net harvest is added to the total finfish catch, the total FY 88 finfish harvest amounts to 149,531.3 Kg.

In addition to finfish, a considerable amount of other organisms was taken from the reefs throughout the year. The estimated gaff and hook catch amounted to a 2,893.4 Kg and was comprised entirely of octopus which was caught at the rate of .32 Kg/gear-hour. Beyond this, the "other methods", such as gleaning, produced an estimated 8.4 m.t. of various crustaceans, gastropods, bivalves, echinoderms and algae with a catch rate of 1.6 Kg/person-hour of fishing effort. Adding the non-fish harvest brings the total island results in a total harvest of 160,873.8 Kg.

The inshore estimated effort and harvest values are based on data that is collected from approximately 10% of the available days in a year. This survey is designed to provide annual estimates and therefore provide decreasing levels of confidence for periods less than a year. The rapid economic, structural and population growth occurring on Guam has also expanded the levels of participation in areas outside the survey area. The limited number of survey days and the underexpansion of actual participation therefore provides for conservative participation and harvest estimates.

Due to legal difficulties with the issuance of submerged lands permits for fish weir operations in Merizo, no permits were awarded during FY 88. Despite the absence of permits, operators continued to use weirs illegally. During this period no catch reports were submitted, making it impossible to determine harvest estimates. The six remaining possible fish weir sites in Cocos Lagoon will be re-opened for legal use once the permit process has been re-established.

RECOMMENDATION

The initiation of computer stored records in FY 82 and the development of the GIES program in FY 85 has greatly reduced the amount of time needed to compile and analyze Guam's inshore fisheries survey data. Because of this, more effort has been spent to continually upgrade our data collection procedures to ensure statistical reliability. Since the inshore fisheries survey provides information important for management and planning, it is recommended that this job be continued. The increased fishing participation and rapid economic and structural development has increased the range of inshore fishing area and therefore requires reinstituting the aerial surveys around Guam to update island-wide participation estimates. During FY 89 the GIES computerized expansion system will be rewritten and upgraded with a new computer hardware system. The GIES system will also be modified to include expansion method alterations which will provide more accurate expansions. The new hardware and software should allow a thorough analysis and comparison of historical data for management applications.

Report prepared by: Gerald W. Davis and Timothy S. Sherwood

Table 1. Combined estimated annual (FY88) inshore fishing participation, effort, and harvest for day and night data for all methods.

Method	No. of Persons	No. of Gear Units	No. of Trips	Person- Hours	Gear- Hours	Catch (Kg)
Hook and Line	34,330.9	34,901.5	25,725.1	129,853.1	131,097.3	26,136.1
Cast Net	6,015.6	5,610.6	5,610.6	18,190.2	16,962.0	14,604.9
Gill Net	8,250.7	3,750.1	23,431.5	37,504.1	17,000.7	25,750.4
Surround Net	1,667.0	333.2	333.2	7,624.0	1,506.0	3,024.5
Spearfishing (SN)	5,173.6	4,885.4	1,955.1	16,516.0	15,562.0	14,857.9
Spearfishing (SC)	564.4	555.9	208.2	2,370.4	2,334.8	5,346.8
Drag Net	132.4	406.5	406.5	387.1	1,189.1	3,810.3
Manahac cast	802.0	502.0	502.0	3,208.0	2,566.4	14,617.9
Manahac drag	639.0	43.0	43.0	3,834.0	958.5	14,382.5
Manahac total	1,441.0	545.0	545.0	7,042.0	6,783.7	29,000.4
Fish totals	57,575.6	50,988.2	58,215.2	219,486.9	192,435.6	122,531.3
Octopus	1,210.9	2,229.5	784.0	3,697.8	3,671.4	2,893.4
"Other"	1,695.1	1,695.1	1,580.1	5,236.7	5,236.7	8,449.1
Totals	60,481.6	54,912.8	60,579.3	228,421.4	201,343.7	133,873.8
Mackeral*						27,000.0
Grand total						160,873.8

*Mackeral were not included in the finfish harvest and effort tables due to the difficulty in obtaining accurate participation data.

Table 2. Estimated annual (FY 88) inshore fishing participation, effort, and harvest for daytime period for all fishing methods.

Method	No. of Persons	No. of Gear Units	No. of Trips	Person- Hours	Gear- Hours	Catch (Kg)
Hook and Line	23,996.8	23,903.2	18,596.2	102,415.9	101,820.5	21,099.6
Cast Net	5,955.4	5,553.2	5,553.2	18,114.8	16,883.4	14,526.3
Gill net	5,274.1	2,582.0	22,263.4	23,449.1	11,456.1	18,840.0
Surround Net	1,667.0	333.2	333.2	7,624.0	1,506.0	3,024.5
Spearfishing	943.9	880.9	330.6	3,126.0	2,896.0	3,659.6
Manahac	1,441.0	545.0	545.0	7,042.0	6,783.7	29,000.1
Fish Totals	39,278.2	33,797.5	47,621.6	161,771.8	141,345.7	90,150.1
Octopus	1,177.1	2,173.2	767.9	3,609.9	3,524.9	2,856.8
"Other"	561.7	561.7	446.7	192.9	192.9	1,135.6
Total	41,017.0	36,532.4	48,836.2	165,574.6	145,063.5	94,142.5

Table 3. Estimated annual (FY 88) inshore fishing participation, effort, and harvest for Nighttime period for all fishing methods.

Method	No. of Persons	No. of Gear Units	No. of Trips	Person- Hours	Gear- Hours	Catch (Kg)
Hook and Line	10,334.1	10,998.3	7,128.9	27,437.2	29,276.8	5,036.5
Cast Net	60.2	57.4	57.4	75.4	78.6	78.6
Gill Net	2,976.6	1,168.1	1,168.1	14,055.0	5,544.6	6,910.4
Spearfishing (SN)	4,229.7	4,004.5	1,624.5	13,390.0	12,666.0	11,198.3
Spearfishing (SC)	564.4	555.9	208.2	2,370.4	2,334.8	5,346.8
Drag Net	132.4	406.5	406.5	387.1	1,189.1	3,810.3
Fish Totals	18,297.4	17,190.7	10,593.6	57,715.1	51,089.9	32,380.9
Octopus	33.8	56.3	16.1	87.9	146.5	36.6
"Other"	1,133.4	1,133.4	1,133.4	5,043.8	5,043.8	7,313.5
Totals	19,464.6	18,380.4	11,743.1	62,846.8	56,280.2	39,731.0

Table 4. FY88 day catch composition for the top species and families harvested.

Species	Harvest(Kg)	%	Family	Harvest(Kg)	%
<i>Selar crumenophthalmus</i>	28,275.8	23.3	Siganidae	33,261.8	27.5
<i>Siganus argenteus</i>	19,246.2	15.9	scads	27,000.0	22.3
<i>Naso unicornis</i>	14,149.4	11.7	Acanthuridae	19,043.6	15.7
<i>Siganus spinus</i>	14,015.6	11.6	Carangidae	9,043.1	7.5
<i>Mulloidichthys flavolineatus</i>	6,248.9	5.2	Mullidae	7,051.0	5.8
<i>Caranx melampygus</i>	5,813.4	4.8	Mugilidae	4,035.1	3.3
<i>Kyphosus cinarascens</i>	4,011.4	3.3	Kyphosidae	4,011.4	3.3
<i>Gerrus spp.</i>	2,971.2	2.5	Lethrinidae	3,146.2	2.6
<i>Liza vaigiensis</i>	2,409.8	2.0	Gerridae	2,971.2	2.5
<i>Lethrinus harak</i>	2,202.4	1.8	Lutjanidae	757.7	0.6
Total all species	121,142.5	82.0	Total	121,142.5	91.1

Table 5. FY88 night catch composition for the top species and families harvested.

Species	Harvest(Kg)	%	Family	Harvest(Kg)	%
<i>Naso unicornis</i>	3,193.0	8.0	Acanthuridae	8,364.7	21.1
<i>Mulloidichthys flavolineatus</i>	2,563.0	6.5	Mullidae	2,890.5	7.3
<i>Naso literatus</i>	1,954.0	4.9	Carangidae	2,644.6	6.7
<i>Caranx ignobilis</i>	1,693.3	4.3	Kyphosidae	2,454.3	6.2
<i>Acanthurus lineatus</i>	1,682.5	4.2	Mugilidae	2,406.9	6.1
<i>Selar crumenophthalmus</i>	1,275.8	3.2	Siganidae	2,253.8	5.7
<i>Lethrinus harak</i>	1,201.0	3.0	scads	1,275.8	3.2
<i>Siganus argenteus</i>	1,186.4	3.0	Lutjanidae	681.3	1.7
<i>Lethrinus elongatus</i>	1,080.2	2.7	Holocentridae	616.1	1.6
<i>Siganus spinus</i>	1,067.4	2.7	Lethrinidae	443.2	1.1
<i>Acanthurus triostegus</i>	925.8	2.3	Gerridae	270.6	0.7
<i>Caranx melampygus</i>	887.5	2.2	Total	39,731.0	61.2
Total all species	39,731.0	47.1			

Table 6. FY88 combined catch composition for the top species and families harvested.

Species	Harvest(Kg)	%	Family	Harvest(Kg)	%
<i>Selar crumenophthalmus</i>	28,275.8	17.6	Siganidae	35,515.6	22.1
<i>Siganus argenteus</i>	20,432.6	12.7	scads	28,275.8	17.6
<i>Naso unicornis</i>	17,342.4	10.8	Acanthuridae	27,408.3	17.0
<i>Siganus spinus</i>	15,083.0	9.4	Canangidae	11,687.7	7.3
<i>Mulloidichthys flavolineatus</i>	8,811.9	5.5	Mullidae	9,941.5	6.2
<i>Caranx melampygus</i>	6,700.9	4.2	Kyphosidae	6,465.7	4.0
<i>Kyphosus cinarascens</i>	4,011.4	2.5	Mugilidae	6,442.0	4.0
<i>Lethrinus harak</i>	3,403.4	2.1	Lethrinidae	3,589.4	2.2
<i>Gerrus spp.</i>	2,971.2	1.8	Gerridae	3,241.8	2.0
<i>Liza vaigiensis</i>	2,409.8	1.5	Lutjanidae	1,439.0	0.9
<i>Naso literatus</i>	1,954.0	1.2	Holocentridae	616.1	0.4
<i>Caranx ignobilis</i>	1,693.3	1.1	Total	160,873.8	83.7
<i>Acanthurus lineatus</i>	1,682.5	1.0			
<i>Lethrinus elongatus</i>	1,080.2	0.7			
<i>Acanthurus triostegus</i>	925.8	0.6			
Total all species	160,873.8	72.7			

Table 7. FY88 rabbitfish harvest during seasonal recruitment in May and June

Date	Method	Island Participation (Persons)	Island Harvest (Kg)
May	Cast Net	468.0	4,863.5
May	Drag Net	463.0	9,754.4
May	Total	931.0	14,617.9
June	Cast Net	317.0	8,673.9
June	Drag Net	135.0	5,708.6
June	Total	452.0	14,382.5
FY 88	Cast Net	785.0	13,537.4
FY88	Drag Net	598.0	15,463.0
FY88	Total	1,383.0	29,000.4

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-25

SUB-PROJECT NO.: F

STUDY NO.: F-1

JOB NO.: 3

JOB TITLE: Fisheries Data Processing

PERIOD COVERED: October 1, 1987 to September 30, 1988.

SUMMARY

During FY 88, offshore and inshore fisheries survey data were entered into computer files and edited for completeness and accuracy. The offshore data base for this fiscal year contains 4,129 records and the "inshore-participation" and "inshore-catch" data bases contain 1,190 and 1,878 records, respectively. The primary software packages used for data analysis were the Guam Offshore Expansion System (GOES) for the offshore fisheries survey data and the Guam Inshore Expansion System (GIES) for the inshore fisheries survey data*. No new data was entered into the data base for Job 8, "Studies of Recreationally Important Reef Fish".

BACKGROUND

Guam's Division of Aquatic and Wildlife Resources (DAWR) has been collecting fisheries information over the past 20 years (with only the last eleven years of data being reliable) and, as a result, an enormous amount of fisheries management data has been accumulated. Computers have been used over the past five years by DAWR to store and analyze this data. DAWR personnel, working closely with the National Marine Fisheries Service, have developed and purchased programs for analyzing the Division's offshore and inshore fisheries survey data.

In FY 83, a program entitled the Guam Offshore Expansion System (GOES) was developed based on the current practices of offshore data analysis and, in FY 85, a Guam Inshore Expansion System (GIES) was completed and tested for errors. Since this time, all data collected for the offshore and inshore fisheries surveys have been analyzed through the use of these two programs.

Job 3, Fisheries Data Processing, has continued to improve over the past fiscal year because of increased familiarity with the computer system by staff biologists. Since its beginning, Job 3 has been jointly funded by the U.S. Fish and Wildlife Service, the

*The "Guam Tournament" module for the GOES was not used in FY88 due to a change in the keeping of the boat record logs. Derby totals for FY 88 are estimates based on expanded data. Details are given in the Annual Report for the Guam International Fishing Derby (GIFD).

National Marine Fisheries Service, and the Western Pacific Regional Fisheries Management Council.

OBJECTIVES

1. Computerize the DAWR's offshore and inshore marine fisheries data and transfer the finalized fisheries data files and reports to NMFS personnel in Honolulu, Hawaii for regional application.
2. Provide technical assistance to DAWR staff biologists in the form of efficient statistical analysis and report generation.

PROCEDURES

Guam's offshore fisheries survey data is analyzed by a system of computer programs known as the GOES. This programming package is a 5-step system that summarizes, sorts, and statistically expands the survey data to produce monthly and annual catch, effort, and species composition estimates. Two proportionality constants and a "total participation boat count" are calculated and manually input into the expansion module by the user. Reports are generated by the GOES that give a breakdown of the estimated offshore harvest by gear type on a monthly and annual basis. Also, an estimated harvest by species is generated for each gear type with a corresponding percentage of the total catch for that gear type.

Guam's inshore fisheries survey data is analyzed by a programming package known as the GIES. The GIES is a 4-step system that relies on two sets of survey data to determine an annual inshore estimated harvest. These two sets of data are referred to as "inshore-participation" and "inshore-catch". "Inshore-participation" data consists of fishermen and gear counts obtained by biological aides when driving around the island and making observations on fishing activity within the fringing reef. "Inshore-catch" data is obtained by fishermen-intercept interviews that usually occur within a predetermined survey region. This data consists of a total catch and catch by species for each interview. Because of the apparent differences in participation and catch-per-unit-effort (CPUE) of the various gear types between daytime and nighttime fishing, a fisheries survey is conducted during each of these two time periods and the data are analyzed separately. Also, data is collected during the seasonal harvest of juvenile rabbitfish (*Siganus sp.*) and bigeye scad (*Selar crumenaphthalmus*), but, because of the dissimilarities between the seasonal fisheries and the routine inshore fisheries, the two are analyzed separately.

RESULTS

Offshore Fisheries Survey Data Base Management

The DAWR's offshore fisheries survey data for FY 88 was entered onto computer files and edited for completeness and accuracy. The total number of records for the FY 88 offshore data base is 4,129. This brings the total number of historical and current offshore records to 20,725. Since the FY 88 GIFD data has not been entered onto the data base, the total number of fishing derby records remains at 1,986.

Based upon the expansion calculated by the GOES, the estimated island-wide offshore harvest for FY 88, including the GIFD results, is about 377 metric tons. For more detailed information, see Job 1, "Offshore Fisheries Survey".

Inshore Fisheries Survey Data Base Management

The FY 88 DAWR inshore fisheries survey data were entered onto two data bases. The "inshore-catch" and the "inshore-participation" data bases for this fiscal year contain 1,878 and 1,190 records, respectively. This brings the total number of historical and current "inshore-catch" records to 22,673 and the "inshore-participation" records to 15,965.

Based upon the expansion calculated by the GIES, the total FY 88 harvest estimate for Guam's inshore fisheries, combining day fishing, night fishing, and seasonal fishing, is approximately 161 metric tons. For more detailed information, see Job 2, "Inshore Fisheries Survey".

Other Fisheries Data Bases

During FY 87, a data base was established for the storage and dissemination reef fish data used for Job 8, "Studies of Recreationally Important Reef Fish". No new records have been entered as analysis has not been completed on the historical records. The total number of records contained in this data base remains at 1,687.

RECOMMENDATION

Data processing has become a valuable asset to the many research projects currently undertaken at DAWR. Data storage and retrieval, data analysis, and report generation has improved greatly since the installation of a computer system, but this system is becoming old and undependable. It is therefore recommended that this office acquire new computer hardware and software to continue this job and update the expansion systems.

Report prepared by: Timothy S. Sherwood

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO: FW-2R-25

SUB-PROJECT NO: E

STUDY NO: F-1

JOB NO: 8

JOB TITLE: Studies of Recreationally Important Reef Fish

PERIOD COVERED: October 1, 1987 to September 30, 1988

SUMMARY

Data on selected aspects of the biology of *S. spinus* were statistically analyzed in order to interpret the reproductive cycle, population biology and to obtain information necessary for predicting the reproductive contribution of adults to the next generation. Two segments of this study are still in progress (growth and fecundity) and will be completed after the next spawning season which is expected to begin in March of 1989.

BACKGROUND

The study of recreationally important inshore reef fish was initiated in FY 82 but was suspended that same year because of competing work priorities resulting from a reduction in staff. In FY 84 a fisheries biologist was hired to continue working on this study.

During FY 84 five species of fish were identified as the most recreationally important reef fish on Guam (*Acanthurus triostegus*, *Caranx melampygus*, *Mulloides flavolineatus*, *Selar crumenophthalmus* and *Siganus spinus*). The determination was based on harvest information obtained from the Division of Aquatic and Wildlife Resources creel survey data (FY 80 to FY 84). Studies were initiated on *S. spinus* and *M. flavolineatus*. Both of these species are harvested throughout the year as sub-adults, adults and seasonally as juveniles. The fishery for these species was analyzed in terms of method and seasonality of harvest for juveniles and adults.

During FY 85, aspects of the reproductive biology of *S. spinus* and *M. flavolineatus* were investigated. They included, male/female sex ratio, spawning activity, size at first maturity, and preliminary fecundity studies. Both species exhibit extended spawning periods punctuated by distinct peaks in spawning activity. Lunar cycles influence timing of spawning activity which centers around the full moon. Field collections were made from October 1984 through September 1985.

During FY 86 this job was inactive because of shifts in staff positions.

OBJECTIVE

The objective of this study is to obtain sufficient information on the history of selected recreationally important reef fish species to permit evaluation of the need for stock management.

PROCEDURES

During FY 88 the previously collected data was analyzed to determine information about the population of the rabbitfish *Siganus spinus* required to assess the need for management and to formulate management criteria. The following parameters were investigated: size class distribution, sex ratio, length/weight relationship for males and females, size at first sexual maturity, reproductive seasonality and spawning frequency. The determination of two other parameters, growth and fecundity, is currently in progress. These are necessary to establish the reproductive contribution of adults to the next generation and are critical elements for the evaluation of the population dynamics of *S. spinus* on Guam. To determine fecundity, egg counts are taken from ripe ovaries which will not be available until the next spawning season in March of 1989. Additionally, an index of fish length vs. gonad weight is needed to estimate the population egg production which is used in calculating percent size class contribution.

RESULTS

Data collection and analysis is still in progress. The final report for Job 8 will be submitted in the Fiscal Year 1989 Annual Report.

RECOMMENDATIONS

The growth and fecundity study should be completed, final data analysis conducted and recommendations for management formulated. Job 8 should be continued to complete the studies on the other species of inshore reef fish identified as being recreationally important on Guam.

Report prepared by: Gretchen R. Grimm

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-25

SUB-PROJECT: E

STUDY NO.: 1

JOB NO.: 11

JOB TITLE: Biomass and Stock Assessment

PERIOD COVERED: October 1, 1987 to September 30, 1988.

BACKGROUND

Effective management of fisheries resources requires an understanding of the effects of fishing pressure on the stocks of target species as well as an understanding of their population dynamics, life histories, ecology, and limits of distribution within the environment. Although harvest estimates for most of Guam's reef fish species are available, little quantitative information on their standing stocks is available. Limited surveys were conducted a number of years ago, but none of these were island-wide in scope, non sampled a complete range of reef zones or habitats, and no attempt was made to obtain quantitative or adequate qualitative information on populations below the practical limits of scuba diving. As the fishing pressure on Guam's recreational reef fishes continues to increase, it is increasingly necessary to obtain quantitative as well as qualitative information on the standing stocks of these fishes and those they interact with in a representative range of reef zones and habitats and, if possible, in relatively unexploited as well as highly exploited areas.

OBJECTIVE

To estimate the biomass of recreationally important fishes harvested at Guam and to assess the general status of their stocks in relation to fishing pressure currently exerted on them.

PROCEDURES

Within each reef zone at each site, the following three types of counts of reef fishes are tentatively planned: (1) visual transects consisting of timed 10 minute replicate counts of all roving species within 5 m of the observer, (2) 5 minute replicate counts of all territorial and non-roving species, and (3) counts to the limit of "recognition visibility" of all individuals of "observer shy" or rare species. It should be noted that several new methodologies for visual counts made by scuba divers have appeared in the literature in recent years (eg. Bohnsack and Bannerot 1985); the potential of a number of these is being investigated and, depending on the results of field trials, one or more of these may be selected over one or more of the above methods. Other methods that may yield valuable information beyond the reach of visual transects made by scuba divers are also being investigated. These include the use of a remote video camera (operated by the University of Guam Marine Laboratory; this method may eliminate the bias caused by observer-shy species leaving the area of a scuba diver) and a deep-diving submersible. Both of these methods will enable certain

kinds of counts to be made to the lower depth limit of the species being investigated (Thresher and Colin, 1986).

RESULTS

During FY 88, additional literature on survey methods was obtained and reviewed, but constraints on manpower precluded additional work. It is anticipated that an improved manpower situation will make it possible to begin collecting baseline data at two sites during FY 89.

RECOMMENDATIONS

It is recommended that this project remain active at a low level until sufficient manpower is available to perform the necessary work.

Report prepared by: Robert F. Myers

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-25

SUB-PROJECT NO.: F

STUDY NO.: F-1

JOB NO.: 12

JOB TITLE: Feasibility Study for the Establishment of Marine Conservation Areas

PERIOD COVERED: January 1, 1988 to September 30, 1988

SUMMARY

The recent increase in total number of hours fishing and a decreasing catch rate shows that severe pressure is being exerted on the inshore fisheries. During the FY 88, the Division of Aquatic and Wildlife Resources implemented a feasibility study for the establishment of a Marine Conservation Area (MCA) to relieve some of this pressure and ease user conflict.

BACKGROUND

In recent years, marine sanctuaries have become an effective tool for managing tropical multi-species fisheries. A sanctuary reserves an area for the protection of marine resources for the enjoyment of non-consumptive recreational users and to provide refuge for breeding stocks that will replenish the island reefs with juveniles.

The DAWR's data base shows that the total harvest for Guam's inshore fishery has decreased by 20% (not including seasonal fisheries) over the past three years (FY 85 to FY 87). One reason for this decline is the increase in user conflicts. A prime example of this conflict is East Agana Bay. This bay is a popular fishing area for the local residents. Over the past few years, a large amount of animosity has been caused between the local fishermen and the jet ski operators that are trying to utilize the same area.

Another major reason for the decrease in harvest is the large amount of pressure that the inshore fisheries is under. The total number of hours that people have been fishing has almost doubled from 161,602 hours in FY 84 to 300,861 in FY 87. Along with this increase, the average catch per hour dropped from 0.55 Kg. to 0.42 Kg. in the same period (not including seasonal fisheries), showing that these fisheries are under severe pressure. Many places have used the sanctuary concept as a way of reducing user conflicts and relieving the pressure that is exerted on the recreational fisheries. An example of a successful sanctuary is Hanauma Bay, Hawaii. In the late 60's, Hawaii experienced a large increase in tourism and heavy fishing pressure. As a result, Hawaii designated Hanauma Bay as a marine life conservation district (sanctuary) where consumptive use of marine life is prohibited, including hook and line, spearfishing, and the collecting of any marine organisms. This area also prohibits all boating activity (including boardsailers, motorboats and jet skis). These prohibitions have lowered the user conflict of the area and also, it seems, to have increased the fish stocks of the area. Out of all areas compared by Kimmerer and Durbin (1975), Hanauma Bay had the highest fish abundance (2320

fish/1000m²) and biomass (6718 Kg./hectare). This area has become so popular that in 1975 it attracted over 20,000 visitors per month.

A sanctuary should be established in an area that has a broad habitat diversity representative of the island's reefs, and is equally accessible to residents as well as visitors. It should be in an area that will benefit recreational users as well as the fishermen of Guam. Conflicts of interest between user groups should be kept to a minimum while surveillance and enforcement should be vigorously adhered too. Safety is also a major factor in selecting an area for a sanctuary as novice swimmers and snorkelers should be in an area that is relatively free from hazards.

OBJECTIVES

To study the establishment of MCA's in order to provide a refuge for over exploited recreationally important fish so they may grow, mature, and reproduce in order to increase their stock in exploited areas.

RESULTS

A literature search has been conducted and provides a basic knowledge of ideas and philosophies in setting up an MCA.

RECOMMENDATIONS

One of Guam's most valuable natural resources are the surrounding coral reefs and associated fisheries. In an effort to maintain and enhance these fisheries, this project should be continued. An area should be selected and a plan developed with the above ideas as key factors.

LITERATURE CITED

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Report prepared by: Tim Sherwood

GUAM FISHERIES DEVELOPMENT
Project F-2-D
Federal Aid in Sport Fish Restoration Act

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: F-2-D-6
SUB-PROJECT NO.: FD 2

JOB TITLE: Construction of Fish Aggregating Devices

PERIOD COVERED: October 1, 1987 to September 30, 1988

SUMMARY

The projected deployment of fisheries aggregating devices (FADs) anticipated for FY88 was delayed due to difficulties in processing a letter of credit through the Government of Guam. After 6 months of correspondence, American Rigging & Supply of San Francisco, Ca. has been contracted to assemble and ship five pre-fabricated mooring systems (chain, nylon rope, polypropylene rope, thimbles, swivels and shackles) for five sites, 400 to 600 fathoms in depth, and to provide materials for five more unassembled mooring systems. This shipment should arrive before the end of calendar year 1988. Once the mooring systems arrive and the depth contour mapping has been completed for each of the proposed sites, the deployments can be initiated. Sites have been identified for the first five deployments (Table 1. and Figure 1.). These sites were selected in 1979 based on fishermen preferences and will be used again based on their previous success and site approval by the Navy and Army Corps of Engineers.

FAD Design

Each FAD consists of a 400 lb surplus Coast Guard buoy which has been refinished and equipped with welded steps and a mount for an eight-cell McDermott Navigational light. These lights should last up to a year before the batteries need to be replaced. In addition, these lights have a back-up bulb system that automatically activates when the primary bulb fails. This should minimize maintenance and safety hazards. Each buoy is attached to an inverse catenary loop mooring system. This mooring design requires 300 fathom depths or greater and is most efficient at depths in excess of 800 fathoms.

The proposed mooring design (Figure 2) is as follows: a 400 lb buoy attached to the following mooring components connected in series: 2.0" safety shackle¹ (SS), 3/4" eye and eye swivel, 3/4" SS, 50 ft. of 3/4" chain, 3/4" SS, 3/4" eye and eye swivel, and a 3/4" SS. The last SS is connected to a predetermined amount of 12 strand plaited 5/8" nylon rope by a nylite thimble. These thimbles have proven very effective on other FAD systems. The recommended process requires that the 12 strand nylon rope be spliced (splice should be tapered) into a predetermined amount of 12 strand plaited 3/4" polypropylene rope. The polypropylene completes the catenary loop and descends to 100 ft. of 3/4" chain to which it is joined identically to the upper chain and nylon only in reverse

¹The original cotter pin in all safety shackles has been replaced with a stainless steel cotter pin

order (thimble, SS, swivel, SS). The bottom chain is then joined to the first concrete anchor with a 3/4" SS, and the first anchor is connected to the second using a length of 3/4" chain. The calculations for the lengths of the nylon and polypropylene vary for each FAD depending on the current, depth, and substrate conditions (South Pacific Commission Handbook No. 24, 1984). The calculations are dependent on how much bottom hardware the designer elects to lift with the polypropylene section. The nylon and polypropylene are recommended to be of 12 strand plaited construction and to be dark in color to limit fishbite and add resistance to ultraviolet light.

Deployment procedures

After the depth contours have been mapped to confirm the feasibility of each site, the deployments can be initiated. Three vessels will be required during each deployment. The Port Authority of Guam's landing craft, the Guahan I, will be contracted to transport and deploy the buoys, moorings, and anchors. A private boat with depth sounding equipment will be chartered to find and mark the proposed site during each deployment. In addition, the Division's 20 ft. vessel will be used to tow the buoy away from the Guahan I.

The entire FAD system consisting of the buoy, assembled mooring system, and anchors will be loaded on-board and connected prior to departure. During loading, the buoy, mooring and anchors will be positioned to allow easy deployment and maximize safety (Figure 3). The two one ton anchors connected in series by chain will be tied down side-by-side on the starboard gunwale toward the opening in the bulwark. The bottom chain will be deployed through this opening. The buoy will be secured on the starboard gunwale near the stern as it will be deployed first. A 5X5X5 ft. crate containing the mooring lines will be placed against the inside starboard bulwark aft of the chain exit opening in the bulwark. A 25 ft. scrap section of chain will be secured on deck along the port bulwark across from the chain exit path on the starboard side. After securing the scrap chain, the 100 ft. bottom chain will be faked out on deck, running back and forth between the scrap chain and the exit opening. Each time the bottom chain comes in contact with the scrap chain, it will be tied with a light cotton string. This will allow the bottom chain to be controlled during deployment. Care will be taken to ensure that the 100 ft. section of chain faked out on deck is not under or around the mooring line crate or near any person working from the crate. After the chain has been faked out on the deck, the mooring system will be connected to the buoy and the anchors. The crate will have been prepacked with the polypropylene on bottom and the nylon on top, with the polypropylene and nylon ends protruding. The nylon rope will be run over the gunwale and attached to the chain leading to the surface buoy, as this end will be deployed first. The polypropylene will then be attached to the faked bottom chain leading to the two anchors. At this time a quick release system will be attached to the top of the bottom chain to prevent the chain and anchors from being pulled off the deck prematurely. The vessel will then be prepared to leave port.

Upon reaching the general vicinity of the proposed deployment area the chartered depth sounding vessel will identify and maintain the exact FAD placement site. The deployment vessel, Guahan I, will move down wind of the deployment site along with the third vessel. The buoy will be deployed first (without the navigational light installed), with the buoy chain and ropes being pulled off the starboard side of the vessel as the barge moves slowly forward into the wind toward the site. The third vessel will stay with the buoy. All three vessels will be in radio contact. At no time will an individual be between the mooring line and the gunwale for safety reasons. The persons deploying line from the crate will have the crate between them and the opening in the starboard bulwark where the faked chain is expected to depart the vessel because, if the anchors release prematurely the faked chain would become a major hazard. Once all the line has been released, the whole system will be towed upwind until 1/3 the length of the mooring system has been pulled past the

deployment site. If the mooring line is not in a straight line from the barge to the buoy after towing, the Division boat (third vessel) will pull the buoy away from the barge until the line is straight but not taut. The purpose of pulling the line straight is so the line will act as a parachute for the anchors. This will help prevent the anchor blocks from breaking upon impact with the bottom and assist in predicting where the anchors will hit bottom (1/3 the length of the mooring). The quick release system will be used to deploy the bottom chain and anchors. The quick release is activated by pulling a line which releases the mechanism securing the upper end of the bottom chain. The release system allows vessel crew to release hazardous equipment from a safe area away from the danger. Once the quick release is triggered, the bottom chain will begin deploying. The cotton cords securing the faked chain should break separately as each tie-down is put under strain during the release of the chain, but in the event they do not, they will be cut from the stern side of the chain. The weight of the chain and the drag of the mooring should be enough to pull the anchors over the side but there may be a need to use a lever from inside the bulwark to assist the anchor deployment. All vessels will have to stay clear of the buoy once the anchors are released as the buoy will be propelled forward at rapid rate. It will take 15- 20 minutes for the anchors to reach the bottom and this is determined by when the buoy stops moving. At this time the McDermott navigational light will be installed and an accurate site location will be recorded.

Project status

During FY 87:

- a) 14 surplus Coast Guard buoys were refinished with welded light mounts and 14 one ton reinforced cement anchors were constructed.

During FY 88,

- a) 16 eight cell McDermott navigational lights were purchased and delivered.
- b) A Purchase order for 20 ft. Division Boat was approved.
- c) Quotations from three private boat owners regarding depth were sounding.received
- d) Preliminary arrangements were made with the Port Authority of Guam to use the landing craft Guahan I for deployment of FADs.
- e) Purchased 5 pre-assembled mooring systems for identified sites, and enough materials for 5 more mooring systems from American Rigging & Supply.

RECOMMENDATION

- 1) Deploy 5 FADs during FY 1989 at pre-selected sites
- 2) Select additonal sites for future deployments

Report prepared by: Gerald Davis

Table 1. U.S. Navy and U.S. Coast Guard permit approved FAD deployment sites.

<u>Site</u>	<u>Depth (Fathoms /Ft.)</u>	<u>Location</u>
1. (Facpi)	570 (3,420)	13°20.2'N/144°36.4'E
2. (Haputo)	400 (2,400)	13°37.1'N/144°46.5'E
3. (Cocos)	600 (3,600)	13°14.0'N/144°37.4'E
4. (Ritidian)	500 (3,000)	13°43.1'N/144°53.9'E
5. (Camel Rock)	500 (3,000)	13°32.1'N/144°42.7'E
6. (Apra)	1000 (6,000)	13°30.2'N/144°35.8'E

Table 2. FAD material and expense list.

<u>Quantity</u>	<u>Item</u>	<u>Cost (\$)</u>
14 (2000 lb)	Cement Block Anchors	\$ 4,000.00
14 (Tear Drop)	Navy Surplus Mooring Buoys	7,000.00
10 (5 sets of 2)	Mooring Systems	26,860.00*
(10 systems)	Shipping Cost	2,564.64**
16	McDermott Navigational Lights	2,740.66**
(5 systems)	Cost to Deploy	3,000.00**

* Money encumbered but not released.

** Money not encumbered but cost confined.

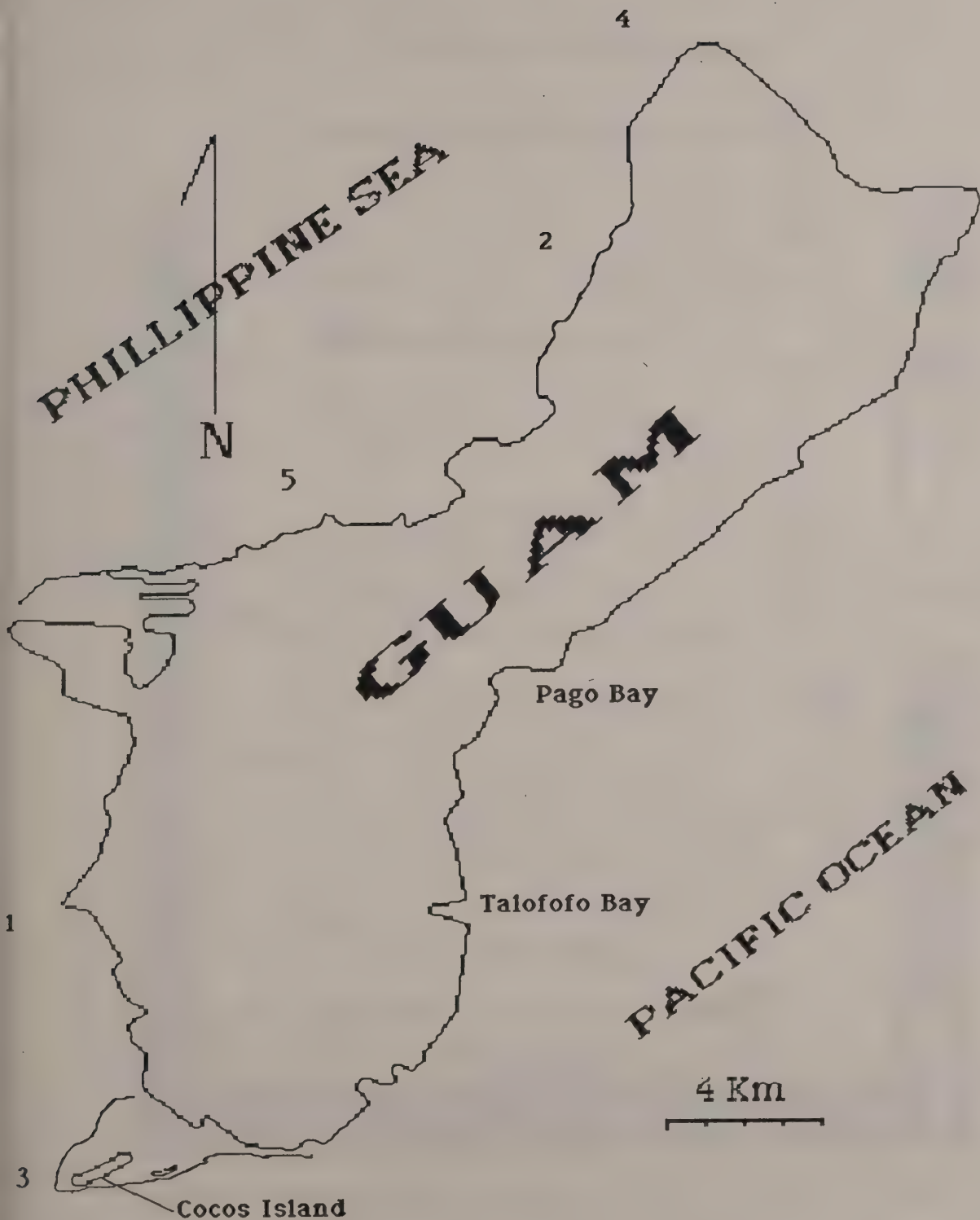


Figure 1. Proposed FAD Sites

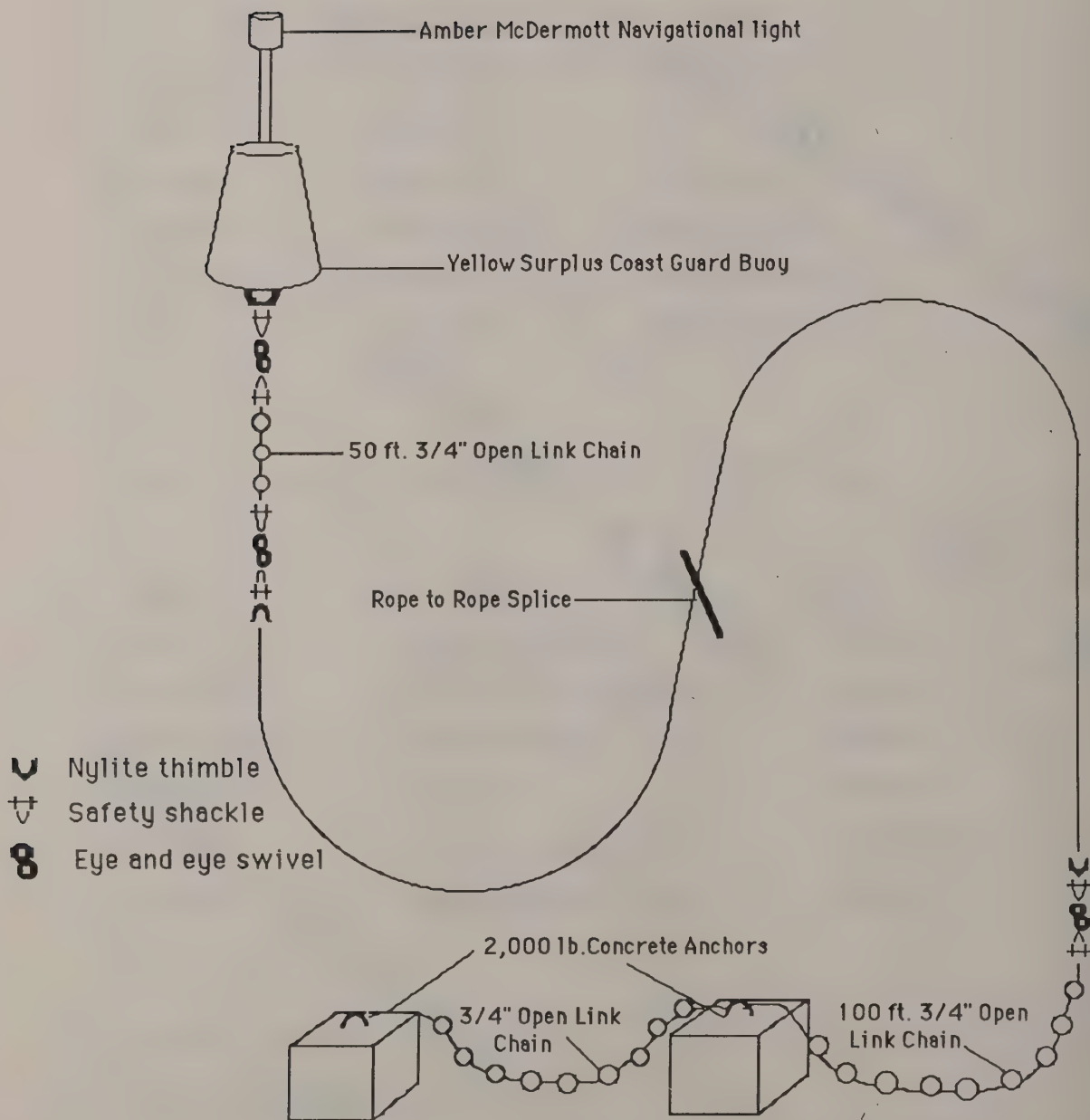


Figure 2. Deepwater (800 Fathom) inverse catenary loop FAD design.

FAD Deployment Barge

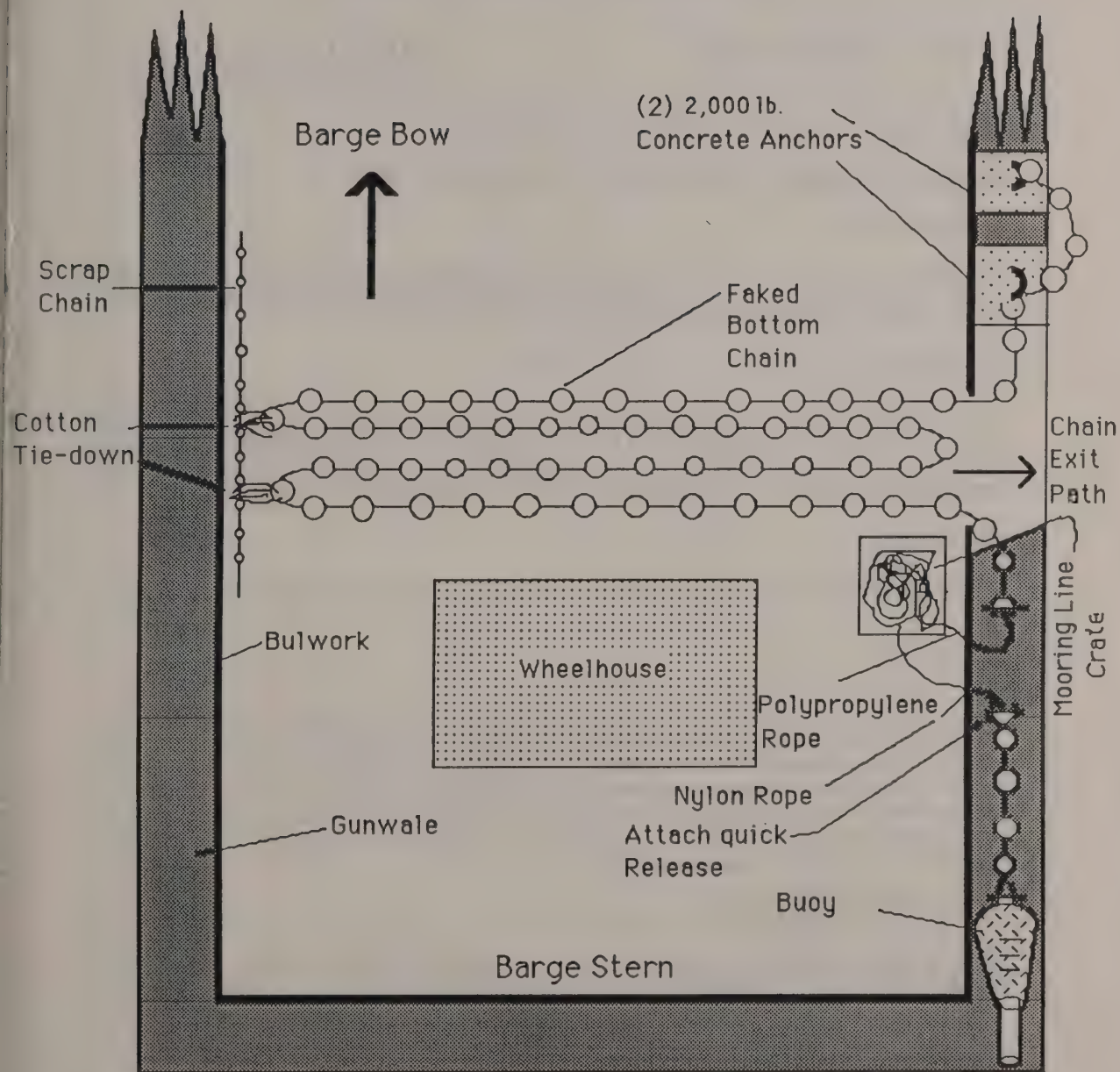


Figure 3. FAD deployment equipment layout.

PROJECT SEGMENT DEVELOPMENT PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: F-2-D-7
SUB-PROJECT NO.: FD 2

JOB TITLE: Construction of Boating Access Facilities

PERIOD COVERED: October 1, 1987 to September 30, 1988

SUMMARY

During FY 88 the Department of Public Works was engaged to design a new, extended pier as an in-house project. The plans are under review and bids for a construction company are expected to go out early in 1989.

BACKGROUND

In FY 86, the objective of the Construction of Boating Access Facilities project was to repair and extend the existing Merizo Pier. An inspection of the existing pier revealed that the structure had deteriorated to the extent that renovation was impractical. During FY 88, the scope of the project was revised to the design and construction of a new pier.

OBJECTIVE

To design and construct a new public pier at Merizo, Guam and to demolish the existing pier

RESULTS

During Fiscal Year 1988, the scope of work for this project was changed from repair and extension of an existing pier to construction and design of a new pier including demolition of the existing structure. Plans to retain an Architecture and Engineering firm to design and carry out the project were dropped and it was decided that the DPW would do the project design in-house and that only the construction would be contracted out. A design that incorporates a handicap access feature is nearing completion and is expected to be ready for the open bidding process early in 1989.

RECOMMENDATIONS

This project should be carried through to completion during Fiscal Year 1989. Construction should be completed within 6 months from the onset of construction activity.

Report prepared by: Gretchen R. Grimm

AQUACULTURE
Funding Source: National Marine Fisheries Service
(P.L. 88-309)
Government of Guam

PROJECT TITLE: Development of Tropical Polyculture Fish Farming

PERIOD COVERED: October 1, 1987 through September 30, 1988.

OVERVIEW

During FY 88, the Division of Aquatic and Wildlife Resources (DAWR) continued to work primarily with the Thai catfish, *Pangasius sutchi*. The catfish received a specially formulated diet to enhance sexual maturation. The three year old female brooders continued to develop immature cream colored eggs and the male brooders produced milt.

The aquaculture program at the DAWR ended on September 30, 1988 due to the termination of PL 88-309. This final report will represent a closure of the project at the DAWR.

ARTIFICIAL REPRODUCTION OF THE THAI CATFISH, *Pangasius sutchi*

Forty-four catfish, *Pangasius sutchi*, brooders continued to be held in an 0.1 hectare pond at Inarajan, Guam. The catfish continued to receive a specially formulated diet to enhance sexual maturation. The male brooders had milt in all months except December and January. The three year old female brooders did not reach sexual maturity during the 1988 breeding season, preventing any intensive work on artificial reproduction and larval rearing.

OBJECTIVES

1. To obtain oogenesis and egg release in the Thai catfish, *Pangasius sutchi*, at Guam.
2. To develop a viable methodology for artificially reproducing *P. sutchi* and for rearing its hatchlings to the fingerling stage at Guam.

PROCEDURES

A 0.1 hectare, triangular-shaped pond with a screened six-inch inflow pipe was used for the project. The water depth in the pond ranged from 0.3 to 1.3 meters with a mean depth of .75 meters. The pond preparation and initial stocking of the forty-four brooders was outlined in the FY 1986 report (Kruckenberg, 1986). Throughout most of the fiscal year, low water levels in the Ajayan River prevented total pond flushing. During this time, the water level in the pond was maintained through routine additions of water. Pond flushing was initiated in July after consistent rains replenished the Ajayan River. The pond was drawn down two feet and refilled every three weeks during July and August to simulate the monsoon season typical in Thailand, and to prevent a possible "repressive factor" which may inhibit fish reproduction in ponds (Swingle, 1956).

A special diet was fed to the brooders five times a week to enhance growth and sexual maturation. The feeding rate was based on 6% of their total biomass, except from March to May when the rate was adjusted to 3% due to the unavailability of some ingredients. From

October, 1987 to August, 1988, the diet included the following items: soybeans, tuna (chum), yellow corn meal, red winter wheat, barley, rice, *Spirulina*, cod liver oil, vitamin E, pelbon, sea salt, calcium phosphate, linseed oil, sunflower oil, ethoxyquin and vitamins/minerals. The monthly allotment of feed given to the fish varied from 2350.0 to 4884.0 grams. The ethoxyquin and a vitamin/mineral supplement were added to the diet in January and February, respectively. The vitamin/mineral supplement was discontinued for one month in April. Barley and *Spirulina* were both missing from the diet in February and July.

Feed preparation required soybeans to be chopped in a blender, steamed for 10 minutes and heated in the oven at 105 C° for 50 minutes. After a complete drying of the chopped soybeans, they along with the grains were weighed into daily allotments, ground to powder, and then bagged. The daily allotment of *Spirulina*, pelbon, sea salt, calcium phosphate and a vitamin mineral supplement were added to each bag. The unmixed powdered feed ingredients, ethoxyquin, cod liver oil, linseed oil, sunflower oil, and vitamin E were chilled while in transport to the pond. Just prior to feeding, the chilled ingredients were mixed and kneaded into a dough-like consistency. The feed was formed into small balls and placed on a feeding tray in the pond. At this time, cloud cover, wind speed, air temperature, water temperature, water color, water level, fish activity, and other general observations were recorded. Records of the maximum and minimum water temperatures between feedings were also kept. Water quality was monitored weekly to determine the alkalinity, carbon dioxide, chlorine (free & total), hardness (calcium & total), dissolved oxygen and pH levels using the Hach methods.

Five brooders (10 % of population) were sampled on a monthly basis to determine the feeding rate and monitor reproductive development. Expecting signs of egg maturation, from March to August fifty percent or more of the brooders were sampled every three weeks to monitor gonadal development, milt production, and fish weights. These samples were collected by stretching a .6 cm mesh seine across one end of the pond and dragging the net to the other end. The uneven bottom, steeply sloped banks and vegetation provided cover which allowed some of the fish to escape being captured. To aid netting operations and limit competition for food, Tilapia, *Oreochromis* sp., fry were removed by dipnet and shoreline vegetation was hand pulled or cut on a weekly basis. Any tilapia captured during netting operation were also removed. Each brooder was examined for the state of reproductive maturation by squeezing to extract milt or using a plastic catheter to suck out eggs. The eggs were observed for color, size and for the presence of yolk. The yolk was identified by placing the catfish eggs into a 70% acetic acid and a 30% alcohol solution (Jhingran and Pullin, 1985) and observed using a magnifying glass.

RESULTS

From March to August 1988 50 to 77 % (24-34 fish per sample) of the brooders were observed at three-week intervals. Partial population samples were taken to limit the stress placed on the fish during netting and processing, and to save water as a total population sample would require draining and refilling the pond.

All male brooders sampled during the project had milt except during the months of December and January. During March and June some of the females sampled had extractable eggs. All female brooders sampled after June had eggs. Egg development occurred much earlier this year, as last year the eggs were first observed in July and no eggs were removed from yearlings. The color of the eggs went from white-cream to a definite cream at the end of the project. There was some individual variability in their

colors with light yellow, greenish, or yellow-orange occurring with some eggs. The size of the eggs varied from 0.6-1.0 mm. All of the eggs had some yolk present. The amount of yolk observed in the center of the egg ranged from a minimal amount to about one third of the egg volume.

The brooders examined during the project exhibited strong sexual differences. The males had a dark red pore for releasing the milt and a majority had a slightly yellow-orange ridge before the vent. The females had a definite ventral opening for the eggs to pass out for fertilization, a very slight ridge before the vent, and the ventral area was enlarged if eggs were present.

Water quality and temperature data provided a log of the pond environmental conditions. The data collected for carbon dioxide, chlorine (total and free), hardness (calcium and total), oxygen, and pH indicated that the values over time remained fairly constant. The alkalinity ranged from 10.0 to 130 ppm with mean of 59.1 and showed the most variability among parameters measured on a month to month basis. Air temperature at the time of daily feeding ranged from 25.5-36.5 C° with a mean for all measurements of 31.2 C°, and water temperature (surface) ranged from 26.5-37.5 C° with a mean of 31.7 C°. The maximum-minimum water temperature (8 to 10 inches below surface) for all readings ranged from 24.0 to 38.5 C° with a mean of 31.0 C°. Occasionally, during the feeding period, some catfish would be seen surfacing for air or swimming near the water surface, which is normal behavior for this catfish species. Even though this catfish should survive low oxygen levels due to its ability to breath atmospheric oxygen, a 24 hr. dissolved oxygen survey was conducted. The results indicated that the oxygen levels where satisfactory.

As a final project measure, five female brooders were sacrificed to check for egg color and ovary size variability. The bi-lobed ovary in each fish ranged 200.3-358.0 grams with a mean of 294.3 grams. Fourteen to twenty-one percent of the female brooders weight consisted of the ovary. All of the eggs in each ovary were cream colored and showed no other color variability. The size of the eggs varied from 0.6-1.0 mm indicating that maturation was consistent throughout the ovary. This would support evidence that these fish spew all their gametes at once and are not serial spawners.

DISCUSSION

There are four primary approaches to the study and research of reproduction in fish, hormonal, environmental, nutritional, and behavioral or social (Lam, 1986). Our involvement with *P. sutchi* began in 1975 when the original stock was obtained from Thailand. When we started work with the brooders, the hormonal approach was used for two years (Kruckenberg, 1981, Kruckenberg, 1982). The use of hormones was abandoned because of unsuccessful egg maturation. The behavioral and social approach were not dealt with directly in this project. It was decided that the environmental and nutritional approaches would be meshed together in future research (Kruckenberg, 1984). In 1985, a new stock of fish was obtained to attempt an alternative approach to developing a practical method of artificially reproducing *P. sutchi*. The shipment of 50 fingerling *P. sutchi* arrived in September of 1985 from Taiwan. The male and female brooders remained together in the pond throughout the study. During FY86 six of the original 50 fish were lost due to flooding (Kruckenberg, 1986). Due to entanglement in the collecting net two male brooders died, one on May 25 and another on July 7, 1988. For unknown reasons two additional fish could not be accounted for in the final count. On August 31, 1988, the field work portion of this project ended. The remaining 40 fish were separated by sex,

weighed and inspected. Twenty five male and fifteen female brooders had mean weights of 1.42 and 1.84 kilograms, respectively. The fish were healthy and the sex was easily determined for each brooder.

Because the *P. sutchi* is a riverine fish and is an omnivore, environmental factors probably have the greatest influence on their reproductive system. The hardest part is to provide an environment that would provide the necessary cues that would trigger their seasonal reproductive cycle. Most fish pass through three stages of gonadal development, oogenesis, ovulation, and spawning. Each of the stages can be directly influenced by the environment. For example in the tropics, the reproductive cycle can be directly influenced by the changes that occur during the wet or rainy season. Fish perceive a wide range of environmental changes, like atmospheric pressure, temperature, wind, or flooding, any of which could trigger egg maturation within the gonad.

One of the major environmental factors that can affect the reproductive cycle of tropical catfish is temperature. The water temperature gradient in a one meter deep pond in Thailand would be about the same as on Guam. There may be a large water temperature gradient difference, however, between a major river and a one meter pond. The catfish, with their omnivorous feeding habits may spend a fair amount of time on the bottom of rivers in cooler water (20-26 C°). In Thailand Potaros and Sitasit (1976) found that ovulation occurs in water between 28 - 32 C°, but no reference was made to pond temperatures necessary for egg maturation. It could be that the water temperature is the most important cue necessary to promote proper egg oogenesis.

In Thailand, these catfish reach maturity in two or three years (Potaros and Sitasit, 1976). Perhaps under Guam's conditions, it may take a fourth year for complete maturation; but, this is unlikely because our climatic conditions are very similar to Thailand.

A lot of emphasis was placed on providing a high protein diet to assist growth and maturation. There has been only a limited amount of information available about feeds for the Thai catfish. We do know that a similar species, *Pangasius pangasius*, would be classified as an omnivore based on the enzymes present in the digestive tract (Ghosh & Saigal, 1981). Ethoxyquin was added to the diet to prevent oxidation of the vitamins and other feed ingredients. The diet seemed to provide ample protein for growth and development of eggs. Both our brooders and catfish in a nearby pond fed a manufactured feed failed to produce viable eggs. This may indicate that there is some factor other than diet that has a dominating influence on the maturation of Thai catfish eggs.

RECOMMENDATION

We have had to discontinue our research with the riverine Thai catfish, *Pangasius sutchi*, due to the termination of PL 88-309. Because we have been unsuccessful with most of our attempts to achieve egg oogenesis, there may be specific environmental conditions that have to be met before the catfish will reproduce. We have held the brooders in a cement raceway, round fiberglass tanks, and a small earthen pond with no success in producing mature eggs. These fish may require a confined river habitat or an earthen raceway with a continuous flow through system. These types of rearing facilities could possibly provide the necessary environmental cues to trigger development of mature eggs. Under the

limitations of the funding, and rearing facilities, we tried to provide an environment that would be suitable for the fish.

The Thai catfish shows promise for pond culture on Guam if artificial reproduction can be achieved. The Thai catfish has a marketable appearance, can breath atmospheric air which allows survival in poor water conditions, grows fast, and the quality of meat is excellent. It is recommended that any further work on the Thai catfish be concentrated on the environmental aspects of egg maturation. Another alternative would be to hybridize the *Pangasius sutchi* male with the *Clarius macrocephalus* female. It has been shown that four morphotypes result from this cross (Tarnchalanukit, 1986). The created morphotypes may increase the marketability of both species.

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Report Prepared by: Wayne Kruckenber

GUAM FISH AND WILDLIFE INVESTIGATIONS
PROJECT FW-2R-25
Federal Aid in Fish and Wildlife Restoration Acts

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-25
SUB-PROJECT NO.: W-1
STUDY NO.: 1
JOB NO.: 1

JOB TITLE: Determination of Current Population Size and Distribution of Guam Deer.

PERIOD COVERED: October 1, 1987 to September 30, 1988.

SUMMARY

Participation in recreational hunting increased during FY 1988 with a total of 620 licenses sold during the fiscal year, an 18% increase over FY 1987 levels. An estimated 353 hunters spent 4,130 hunter-days and harvested 37 deer. Hunter success at 10.4% was lower than the previous year and 22% more effort was expended per deer harvested (111.6 days/deer in FY 1988). A special either-sex hunt was held at Pati Point on Andersen Air Force Base (AAFB) during the months of January, February, and September 1988. Two-hundred-fifteen special hunt tags were issued and hunters spent 389 hunter-days and harvested 41 deer. The gun special hunts provided the best opportunity to harvest a deer with just 5.4 hunter-days spent for each deer harvested. The most popular deer hunting areas on island were Northwest Field (NWF), bow areas on Andersen Air Force Base, and Naval Communication Area Master Station (NAVCAMS). Deer hunters also reported hunting the Bolanos, Anao, and Cotal (Tarzan Falls) Territorial Conservation Reserves and private property. Population trend data obtained with spotlight counts indicated a significant ($P=0.03$) increase in deer numbers at AAFB and Naval Magazine ($P=0.004$) and a non-significant increase in water buffalo numbers at the Naval Magazine ($P>0.20$).

BACKGROUND

The Guam deer has been under investigation by the Division of Aquatic & Wildlife Resources since 1961. Its distribution, population trends and biology have been described by Wheeler (1979). Deer hunting statistics have been compiled since 1968 through hunter reporting procedures. The regular deer season is October 1 through December 31 with a bag limit of one antlered deer (buck only) per season per license holder exclusive of any special hunt harvest. The Director of Agriculture can authorize a special either-sex hunt to thin a particular herd in situations where the population poses a threat to life and property and to prevent damage to other natural resources from over grazing.

OBJECTIVES

To determine the current size and distribution of the deer population of Guam and to monitor population trends.

PROCEDURES

1. Continue spotlight counts on AAFB at 21 counts per year, 4 per month in May - July and one per month in other months.
 - a. Record number, age, sex and group composition.
 - b. Statistically analyze count data and compare with past data to discern population trends.
2. Continue monthly spotlight counts on Naval Magazine with periodic spotlight counts in other areas.
3. Collect hunting statistics via a hunter questionnaire. Analyze hunting statistics for changes in hunter kill, effort, and hunting location.
4. Collect biological data from carcasses killed during regular season and special hunts or from incidental sources such as road kills or confiscated animals.

RESULTS

Deer Hunting Statistics

License sales increased 18% in FY 1988 with 620 licenses sold during the year (Table 1). All license holders were mailed a harvest questionnaire and responses were obtained from 135 persons (22%). Eighty-one percent of the respondents indicated they had hunted at some time during the year long season. Based on that percentage, an estimated 505 persons legally hunted game during the past year.

The number of active hunters that pursued deer during the regular season increased 10% during FY 1988 to 353 persons but that number comprised a smaller percentage (70% in FY 1988 versus 91% in FY 1987) of the hunting public (DAWR 1987). This drop in proportionate participation appears to be the result of greater interest in hunting late in the license year after the regular deer season closed. Hunter success at 10.4% dropped slightly from the 16.7% reported in FY 1987. Of the 8 deer that were reported as harvested in the questionnaire, three came from Northwest Field and a single deer came from AAFB bow areas, NAVCAMS, Anao, Tarzan Falls, and private property in southern Guam. Seven of these deer were taken by shotgun and one was with a bow. An average of 11.7 days were spent hunting deer by the reporting hunters, slightly less than the 15.4-day average reported in FY 1987.

Estimates of total hunter participation, effort, and harvest were derived from the questionnaires. Based on these data, an estimated 353 hunters spent 4,130 days hunting and harvested 37 deer, a 10% increase in participation, 31% decrease in harvest, and a 16% decrease in effort over FY 1987 levels. Deer hunters expended an average of 111.6 hunter-days of effort per deer harvested, a slight increase over the 91.5 days/deer expended in FY 1987.

The military bases on the northern end of the island remained the preferred areas to hunt deer. Andersen Air Force Base (Northwest Field and bow areas on AAFB) and NAVCAMS were hunted by 48% and 30%, respectively, of the responding hunters. Bolanos, Anao, and Cotal (Tarzan Falls) Territorial Conservation

Reserves were hunted by 10%, 9%, and 6%, respectively, and private property was hunted by 9% of those responding.

The shotgun remained the most frequently used weapon with 64% of the responding hunters using it for deer hunting. The bow was next in popularity and used by 34% of the respondents. Handguns and rifles were less popular and used by 12% and 5%, respectively, of those responding.

A record of hunting activity and harvest is normally kept at NAVCAMS and Andersen Air Force Base. Harvest and effort data is available from Andersen Air Force Base for the entire deer season but changes in reporting procedures prevented compilation of a complete set of hunting statistics at NAVCAMS. The only data available is on numbers of animals harvested (Table 2). A total of six deer were harvested this past year, an increase from the 4 recorded in FY 1987.

Twenty-six deer were harvested during the regular season at Northwest Field, a considerable increase from the 18 taken there the previous year (Table 2). Hunting effort also increased there this year with 1,077 hunter-sorties and 687 hunter-days spent hunting. Bow areas received little hunting pressure this year and did not account for any harvest.

Special either-sex hunts were held at Pati Point during the months of January, February, and September 1988. Two-hundred-fifteen tags were issued and 389 hunter-days were spent hunting deer in these special hunts. Forty-one deer were harvested of which 23 were bucks and 18 were does. The gun special hunts provided the best opportunity to harvest a deer with just 5.4 hunter-days spent per each deer harvested.

Spotlight Count Trends

Deer numbers remained high on AAFB during FY 1988 (Table 3). Numbers observed during the best 3 months of the year for sighting deer, May-July, increased significantly (16%) over FY 1987 levels (Mann-Whitney U-Test, $U = 110$, $n_1=12$, $n_2=12$, $P=0.03$, Sokal and Rohlf 1981). The average number of deer seen per count increased from 113.3 during May-July, 1987 to 131.4 during May-July, 1988. However, numbers observed throughout the entire year did not vary statistically from those recorded the previous year (Mann-Whitney U-Test, $U = 257.5$, $n_1=21$, $n_2=21$, $P=0.35$, NSD). The average number of deer seen per count (October-September) increased slightly (5%) from 109.2 in FY 1987 to 115.2 in FY 1988. The largest count decreased from 181 (270 deer per 10 km) to 166 (231 deer per 10 km).

Deer numbers observed on Naval Magazine continued to increase for the third year in a row. The average number of deer seen per count increased from 9.0 deer in FY 1987 to 18.3 deer in FY 1988 (Table 4). This increase was statistically significant (Mann Whitney U-Test, $U=122.5$, $n_1=12$, $n_2=12$, $P=0.004$) and confirms the previous years conclusion that the population may be reversing the declining trend that occurred in the early 1980s. As further evidence of a rebound in numbers, the largest count recorded during FY 1988 nearly doubled from 18 deer (7.7 deer per 10 km) in FY 1987 to 32 deer (15.4 deer per 10 km) in FY 1988.

Feral Asiatic Water Buffalo

Water buffalo (carabao) numbers changed little during FY 1988. The average number of water buffalo seen per count increased slightly (3%) from 36.4 in FY 1987 to 37.6 in FY 1988 (Table 4) but that increase was not statistically significant (Mann-Whitney U-Test, $U=72$, $P>0.20$). The largest number seen on a monthly count increased from 68 (25.2 carabao per 10 km) in FY 1987 to 81 (34.7 carabao per 10 km) in FY 1988.

RECOMMENDATION

Continue spotlight counts at present intensity at NAVMAG and AAFB. Collect biological data from carcasses as available.

LITERATURE CITED

- Division of Aquatic and Wildlife Resources Division. 1987. Job Progress Report. Federal Aid to Fish and Wildlife Restoration. Div. Aquatic and Wildl. Res., Dep. Ag., Mangilao.
- Sokal, R. R. and F. J. Rohlf. 1981. Biometry. W. H. Freeman and Co. 859 pp.
- Wheeler, M.E. 1979. The biology of the Guam deer. Tech. Rept. No. 3. Div. Aquatic and Wildl. Res., Dep. Ag., Mangilao. 53 pp.

Report prepared by: Paul J. Conry

Table 1. Island-wide deer hunting statistics for FY 1988 based on hunter responses to a harvest questionnaire.

a. Total license sales for all game species	620
b. Number of questionnaires sent out	620
c. Number of hunter questionnaires returned	135
d. Percent of queried license buyers that responded.....	21.8%
e. Number of reporting license buyers (135) that hunted any species	110
f. Percent of license buyers that hunted any species	81.5%
g. Estimated total number of legal hunters.....	505
h. Number of reporting hunters (110) that hunted deer during the regular season .	77
i. Percent of reporting hunters that hunted deer during the regular season.....	70%
j. Number of deer taken by 77 reporting deer hunters.....	8
k. Hunter success.....	10.4%
l. Estimated total number of legal deer hunters.....	353
m. Estimated total legal deer take.....	37
n. Hunter-days expended by 77 reporting deer hunters.....	901
o. Average number of days spent per reporting deer hunter.....	11.7
p. Estimated total number of days spent hunting deer.....	4130
q. Number of days spent hunting per deer taken	111.6

Table 2. Hunter effort and deer take based on official hunter logs from Naval Communication Area Master Station (NAVCAMS), Northwest Field, and bow areas and special hunts on Andersen Air Force Base during FY 1988.

	Oct	Nov	Dec	Jan	Feb	Sept	Total
NAVCAMS							
Deer taken	0	2	4				6
Anderson Air Force Base							
Northwest Field							
No. hunter-sorties	370	381	326				1077
No. hunter-days (8-hr)	233.5	249.5	204.0				687
Deer taken	15	8	3				26
Days effort/take	15.6	31.2	68.0				26.4
Bow Area at Conventional Weapons Storage							
No. hunter-days	29	41	54				124
Deer taken	0	0	0				0
Days effort/take	--	--	--				--
Bow Areas on Main Base							
No. hunter-days	.2	4	60				66
Deer taken	0	0	0				0
Days effort/take	--	--	--				--
Special Hunt -Gun							
No. hunter-days				65	61	69	195
Deer taken				15	9	12	36
Days effort/take				4.3	6.8	5.7	5.4
Special Hunt -Bow							
No. hunter-days				51	27	116*	194
Deer taken				2	0	3	5
Days effort/take				25.5	--	25.3	38.8
Totals Andersen Air Force Base							
No. hunter-days	264.5	294.5	318	116	88	185	1266
Deer taken	15	8	3	17	9	15	67
Days effort/take	17.6	36.8	106.0	6.8	9.8	12.3	18.9

*Number of hunter-sorties rather than hunter-days.

Table 3. Composition of deer herd seen during spotlight counts at Andersen Air Force Base, during FY 1988.

		1987			1988									Summary Statistics			
	COUNT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL	Ave.	SD	CV-%
Unclassed buck	1 2 3 4 Ave.	2 2.0	7 7.0	1 1.0	1 1.0	2 2.0	4 4.0	2 2.0	3 1.8	1 2.3	5 3.0	3 3.0	5 5.0	55	2.6	1.7	67
Spike	1 2 3 4 Ave.	1 1.0	2 2.0	1 1.0	2 2.0	3 3.0	0 0.0	0 0.0	1 2.8	1 2.3	3 2.8	2 2.0	4 4.0	46	2.2	1.4	66
2pt	1 2 3 4 Ave.	2 2.0	1 1.0	0 0.0	1 1.0	0 0.0	1 1.0	4 4.0	6 6.0	4 4.5	2 1.0	5 5.0	0 0.0	60	2.9	3.5	122
3pt	1 2 3 4 Ave.	1 1.0	5 5.0	2 2.0	1 1.0	2 2.0	3 3.0	1 1.0	5 4.3	1 5.3	5 4.3	7 7.0	2 2.0	79	3.8	2.2	58
4pt	1 2 3 4 Ave.	0 0.0	0 0.0	0 0.0	0 0.0	0 0.0	1 0.0	0 0.0	0 0.0	0 1.5	0 0.0	2 2.0	0 0.0	9	0.4	0.9	203
Doe	1 2 3 4 Ave.	43 43.0	47 47.0	33 33.0	35 35.0	29 29.0	41 41.0	33 33.0	59 67.3	58 56.0	56 52.5	68 54.0	60 43.0	1092	52.0	15.4	30
Yearling	1 2 3 4 Ave.	5 5.0	10 10.0	9 9.0	9 9.0	4 4.0	4 4.0	1 1.0	5 8.0	5 8.0	7 8.0	5 5.0	4 4.0	147	7.0	2.8	41
Fawn	1 2 3 4 Ave.	4 4.0	10 10.0	7 7.0	3 3.0	4 4.0	5 5.0	7 7.0	10 9.3	6 5.5	5 3.5	3 3.0	10 10.0	126	6.0	2.7	46
Unclassed-deer	1 2 3 4 Ave.	28 28.0	21 21.0	27 27.0	22 22.0	29 29.0	45 45.0	38 38.0	44 43.5	53 51.5	34 39.8	29 29.0	27 27.0	805	38.3	10.6	28
Total	1 2 3 4 Ave.	86 86.0	103 103.0	80 80.0	74 74.0	73 73.0	104 104.0	86 86.0	133 142.8	129 136.8	117 114.8	124 124.0	112 112.0	2419	115.2	26.9	23
Miles (Ave.)		4.5	4.4	4.4	4.0	4.0	4.3	4.0	4.5	4.1	4.2	4.5	4.5				
Km (Ave.)		7.2	7.0	7.0	6.4	6.4	6.9	6.4	7.2	6.6	6.7	7.2	7.2				
Deer/10 mi (Ave.)		191.1	234.1	181.8	185.0	182.5	241.9	215.0	317.2	333.5	273.2	275.6	248.9		240.0	52.2	22
Deer/10 km (Ave.)		119.4	146.3	113.6	115.6	114.1	151.2	134.4	198.3	208.5	170.8	172.2	155.6		150.0	32.6	22
Bucks-in-velvet	1 2 3 4 Ave.	1 1.0	7 7.0	1 1.0	1 1.0	1 1.0	1 1.0	0 0.0	1 0.8	0 1.3	3 1.3	3 3.0	4 4.0	32	1.5	1.7	111

Table 4. Composition of deer herd seen during spotlight counts at Naval Magazine, Guam during FY 1988.

	Summary Statistics											
	1987						1988					
	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
Unclashed buck	0	2	0	1	1	1	1	1	1	0	1	1
Spike	0	2	1	0	1	1	1	1	0	1	0	1
2pt	2	1	2	4	3	0	4	4	4	1	0	0
3pt	0	0	0	0	1	0	0	1	0	0	0	0
4pt	0	0	0	0	0	0	0	0	0	0	0	0
Doe	3	6	4	5	13	2	0	14	0	1	0	5
Yearling	0	0	1	0	1	1	17	14	12	11	7	2
Fawn	1	1	0	1	0	2	1	1	2	1	0	2
Unclashed deer	4	1	1	5	2	11	6	4	1	4	3	3
Total	10	13	9	16	22	18	32	28	27	20	11	13
Miles traveled	12.9	14.7	16.1	13.0	13.0	14.5	12.9	14.9	12.9	14.7	14.9	19.0
Km traveled	20.8	23.7	25.9	20.9	20.9	23.3	20.8	24.0	20.8	23.7	24.0	30.6
Deer/10 mi	7.8	8.8	5.6	12.3	16.9	12.4	24.8	18.8	20.9	13.6	7.4	6.8
Deer/10 km	4.8	5.5	3.5	7.6	10.5	7.7	15.4	11.7	13.0	8.5	4.6	4.3
Water Buffalo	40	26	43	24	44	81	27	44	47	24	34	17
Buffalo/10 mi	31.0	17.7	26.7	18.5	33.8	55.9	20.9	29.5	36.4	16.3	22.8	8.9
Buffalo/10 km	19.3	11.0	16.6	11.5	21.0	34.7	13.0	18.3	22.6	10.1	14.2	5.6
	TOTAL											
	10	8	10	8	10	8	10	8	10	8	10	8
Ave.	0.8	0.7	0.65	0.7	0.65	0.7	0.65	0.7	0.65	0.7	0.65	0.7
SD	0.58	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
CV-%	69	98	88	181	60	86	72	66	42	48	45	46

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-25

SUB-PROJECT NO.: W-1

STUDY NO.: 2

JOB NO.: 2

JOB TITLE: Population Size and Distribution of Wild Pigs on Guam.

PERIOD COVERED: October 1, 1987 to September 30, 1988.

SUMMARY

Participation in recreational hunting increased 18% during FY 1988 with a total of 620 licenses sold. Corresponding to this increase in license sales, the number of hunters that hunted pigs during FY 1988 also increased. An estimated 409 pig hunters spent 9,775 hunter-days and harvested an estimated 1,992 pigs, an increase of 37% in hunter participation, 49% in hunter effort, and 142% in harvest from FY 1987 levels. Hunter success remained high at 75% and the average take per successful hunter nearly doubled from 3.67 pigs in FY 1987 to 6.37 pigs. The effort expended per pig harvested decreased from 8.0 days/pig in FY 1987 to 4.91 days/pig in FY 1988. Andersen Air Force Base and Naval Communications Area Master Station (NAVCAMS) were the most popular pig hunting areas on Guam with Anao, Bolanos, and Cotal (Tarzan Falls Territorial Conservation Reserves and other private lands also identified as areas hunted. The official logs recording harvest statistics on military bases were incomplete this year, but, the records that were provided for NAVCAMS (Jan - Sept) documented effort, harvest, and effort/harvest of 1,165 hunter-sorties, 727.5 hunter-days, harvest of 80 pigs (Oct-Sept harvest of 114 pigs), and effort/harvest of 9.1 hunter-days per pig. At Northwest Field, recreational hunters expended 1,502 hunter-sorties comprising 956.5 hunter-days to harvest 151 pigs with an effort/harvest of 6.3 days per pig.

BACKGROUND

The wild pig (*Sus scrofa*) is one of Guam's most popular game mammals. The wild pigs on Guam descend from stock introduced by the Spanish during their 300-year rule on the island. Wild pigs are found island-wide but appear to be most numerous in the limestone forests of the north and the ravine forests of southern Guam. Depredation on agricultural crops is often a problem, especially for farmers in southern Guam during the dry season. Fieldwork on pigs in the past has been concentrated on military lands. There is a need to assess pig populations in other areas of the island, particularly in the south, where pigs may be under-harvested and where crop damage by pigs is a common complaint. Hunting Regulations promulgated on March 28, 1987 extended the hunting season for pigs to year-round throughout the island with bags limits of 2 pigs per day and 40 per season.

OBJECTIVES

To monitor trends in pig population size and hunter participation and harvest.

PROCEDURES

1. Record pig sightings during deer spotlight counts, and observations of pigs or pig sign during other fieldwork.
2. Monitor hunter participation and harvest during the legal hunting season.

RESULTS

License sales increased 18% in FY 1988 with 620 licenses sold during the year (Table 1). All license holders were mailed a harvest questionnaire and responses were obtained from 135 persons (22%). Eighty-one percent of the respondents indicated they had hunted at some time during the season. Based on that percentage, an estimated 505 persons legally hunted game during the year, an increase of 43% over FY 1987 levels (DAWR 1987).

Of the 110 active hunters responding to the questionnaire, 81% indicated they had hunted pigs during the FY 1988 season (Table 1). Hunter success remained high with 75% of the reporting hunters harvesting at least one pig during the year-long season. The average take per hunter increased considerably this past year from 2.75 pigs in FY 1987 to 4.87 pigs in FY 1988. Likewise, the average take per successful hunter increased from 3.67 pigs in FY 1987 to 6.37 pigs in FY 1988. Pig hunters spent about the same amount of time in the field this year as last, an average of 24 days per hunter, slightly more than the 22-day average in FY 1987. Considerably less effort was expended per pig harvested, 4.91 hunter-days in FY 1988 in contrast to the 8.0 hunter-days per pig in FY 1987.

Estimates of hunter participation, effort, and harvest were derived from hunter questionnaires. An estimated 409 pig hunters spent 9,775 days hunting pigs and harvested 1,992 pigs during FY 1988. Those estimates are consistently higher than the estimated 299 hunters that spent 6,548 days and harvested 822 pigs in FY 1987. FY 1988 had an increase in hunter participation of 37%, hunter effort of 49%, and hunter harvest of 142%.

Although the data indicated a large increase, the estimated total hunter participation, effort, and harvest seem far higher than actual activity and are likely over-estimates of effort and take. These results reflect the bias typical of hunter questionnaires where successful hunters are far more likely to report their activities than unsuccessful ones. Consequently, information derived from this questionnaire is more useful as an index of hunter activity than as an absolute estimate of it.

The shotgun remained the weapon of choice for most pig hunters and was used by 65% of reporting hunters. Archery hunting was next in popularity with 36% of the reporting hunters hunting with bows. Handguns and rifles were used by fewer hunters, 13% and 11%, respectively.

The military bases on the northern end of the island remained the most popular areas to hunt. Andersen Air Force Base (Northwest Field and bow areas) and NAVCAMS were hunted by 47% and 28%, respectively, of the reporting hunters. Private property was hunted by 18% of responding hunters and Anao, Bolanos, and Cotal (Tarzan Falls) Territorial Conservation reserves were hunted by 10%, 7%, and 6%, respectively, of responding hunters.

A record of hunting activity and harvest is normally kept at NAVCAMS and Andersen Air Force Base. However, changes in reporting procedures prevented compilation of a complete set of hunting statistics for both bases this past year. A complete set of data is available for the entire year from Northwest Field but only a partial set of data (October-February) is available from bow areas on AAFB and from NAVCAMS (January-September). As such, the values given below for hunter statistics are incomplete.

The number of pigs harvested on NAVCAMS during FY 1988 declined from 155 during FY 1987 to 114 during FY 1988. Hunter effort for 9 months totaled 1,165 sorties, just slightly more than the 1,123 recorded for the same period during the previous year and harvest during this period was 80 pigs (79 for same period in FY 1987). It required about the same amount of effort to take a pig at NAVCAMS this year as last, 14.6 sorties/pig (9.1 hunter-days/pig) in FY 1988 (based on 9 months data) versus 14.5 sorties/pig in FY 1987.

The harvest at Northwest Field (151 pigs) declined 11% from FY 1987 levels (Table 2). Hunting effort also decreased 7% from 1,028.5 hunter days in FY 1987 to 956.5 hunters in FY 1988. It required slightly more effort to harvest a pig this year in Northwest Field, 6.3 hunter-days in FY 1988 in contrast to 6.1 hunter-days in FY 1988.

The archery effort and harvest was way down this year in comparison to FY 1987 (Table 2). However, this is likely a product of incomplete reporting. Just 224 hunter-sorties were reported for FY 1988 in contrast to the 699 reported last year. Harvest was also greatly reduced from the 101 pigs in FY 1987 to 29 this year. No data were provided for the months of February through September and harvests and effort were no doubt higher than that reported here.

RECOMMENDATIONS

Continue to monitor the annual pig harvest and hunter participation.

LITERATURE CITED

Division of Aquatic and Wildlife Resources. 1987. Job Progress Report - Federal Aid to Fish and Wildlife Restoration. Guam Dept. of Agriculture.

Report prepared by: Paul J. Conry

Table 1. Pig hunting statistics for FY 1988 compiled from a harvest questionnaire.

a.	Total license sales for all game species	620
b.	Number of questionnaires sent out.....	620
c.	Number of questionnaires returned	135
d.	Percent of queried license buyers that responded	21.8%
e.	Number of reporting license buyers (135) that hunted any species	110
f.	Percent of license buyers that hunted	81.5%
g.	Estimated total number of legal hunters	505
h.	Number of reporting hunters (110) that hunted pigs.....	89
i.	Percent of reporting hunters that hunted pigs.....	80.9%
j.	Number of successful pig hunters	68
k.	Hunter success	76.4%
l.	Number of pigs taken by the 68 successful pig hunters.....	433
m.	Average number of pigs taken per pig hunter.....	4.87
n.	Average number of pigs taken per successful hunter	6.37
o.	Number of hunter days expended by 89 reporting pig hunters.....	2133
p.	Average number of days spent per reporting pig hunter.....	23.9
q.	Estimated total number of legal pig hunters.....	409
r.	Estimated total legal pig take.....	1992
s.	Estimated total number of days spent hunting pigs	9775
t.	Days of hunting effort per pig taken	4.91

Table 2. Hunter effort and pig take based on official hunter logs from Naval Communications Area Master Station (NAVCAMS) and Andersen Air Force Base during FY 1988.

	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Total
NAVCAMS													
No. hunter sorties				93	142	127	90	155	98	154	143	163	1165
No. hunter days (8-hr)				66	80	86	68	98.5	64	90.5	84	90.5	727.5
Pigs taken	13	15	6	8	12	11	6	10	8	15	3	7	114
Days effort/take				8.3	6.7	7.8	11.3	9.9	8.0	6.0	28.0	12.9	9.1*
Andersen Air Force Base													
Northwest Field													
No. hunter sorties	370	381	326	56		94	71	49	20	41	94		1502
No. hunter days (8-hr)	233.5	249.5	204	33		62.5	44.5	29	12.5	21.5	66.5		956.5
Pigs taken	34	31	27	8		12	8	8	2	7	14		151
Days effort/take	6.9	8.0	7.6	4.1		5.2	5.6	3.6	6.3	3.1	4.8		6.3
Bow Areas at Conventional Weapons Storage													
No. hunter sorties	29	41	54	27									151
No. hunter days (8-hr)	29	36	40.5	24.5									130
Pigs taken	7	3	11	8									29
Days effort/take	4.1	12.0	3.7	3.1									4.5
Bow Areas on Main Base													
No. hunter sorties	2	4	60	7									73
No. hunter days (8-hr)	2	4	60	7									73
Pigs taken	0	0	0	0									0
Days effort/take	--	--	--	--									--
Totals Andersen Air Force Base													
No. hunter sorties	401	426	440	90		94	71	49	20	41	94		1726
No. hunter days (8-hr)	264.5	289.5	304.5	64.5		62.5	44.5	29	12.5	21.5	66.5		1159.5
Pigs taken	41	34	38	16		12	8	8	2	7	14		180
Days effort/take	6.5	8.5	8.0	4.0		5.2	5.6	3.6	6.3	3.1	4.8		6.4

*Days effort/take was calculated using only data for months January-September.

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-25

SUB-PROJECT NO.: W-2

STUDY NO.: 1

JOB NO.: 2

JOB TITLE: Population Numbers and Distribution of Philippine Turtle-Doves.

PERIOD COVERED: October 1, 1987 to September 30, 1988.

SUMMARY

The Philippine Turtle-Dove (*Streptopelia bitorquata*) hunting season remained closed during this fiscal year as dove numbers remain low throughout most of the island. The decline in the population may have bottomed out as surveys conducted this year suggest signs of stabilization in northern populations and an increase in southern populations. For the first time in three years, stationary counts at Northwest Field (NWF) and roadside counts at the Conventional Weapons Storage Area (CWA) on Andersen Air Force Base were not significantly lower than the previous year (NWF: $P = 0.40$, CWA: $P = 0.90$). An average of 24.2 doves were recorded per count at NWF, up 8% from FY 1987 levels and an average of 23.1 doves were recorded per count at the CWA, down 4% from FY 1987 levels. Turtle-doves remain distributed throughout the island and were observed on all 23 spring game bird surveys conducted during June 1988 and numbers appear to be increasing throughout the island. The number of doves observed per station increased on 15 routes, remained the same on 2 routes, and decreased on 6 routes. These data reflect a general trend that is statistically significant ($P = 0.08$) rather than random fluctuations in local populations. This trend was most consistent on the 11 southern routes where dove numbers increased on 8 routes, remained the same on 2 routes, and decreased on just 1 route ($P = 0.05$). Doves were found in high numbers (≥ 1.0 birds/station) at Cocos Island, CWA, NWF, Ija, Mt. Santa Rosa, Tarague, Navy Golf Course in Barrigada, and Reserve Craft Beach Road. The largest increase in numbers occurred at the CWA where the average station count increased 2.10 birds/station.

BACKGROUND

The Philippine Turtle-Dove (*Streptopelia bitorquata*) was introduced to Guam by the Spanish during their early colonization of the region, circa 1771 (Baker 1951) and has been regulated as a game bird since as early as 1903 (Conry 1987). Up through the early 1960s, the turtle-dove was very common and found in large numbers in both northern and southern Guam. By the late 1960s, dove populations in southern and central Guam began to decline and have since stabilized at low levels. Populations in northern Guam declined in the late 1970s and early 1980s. Turtle-doves are now found in appreciable numbers in prime dove habitat on Northwest Field, Conventional Weapons Area and elsewhere on Andersen Air Force Base and at moderate numbers in selected areas of central and southern Guam. A large population still remains on snake-free Cocos Island. Predation by the brown tree snake (*Boiga irregularis*) is the major cause of nest loss (Conry 1988) and this introduced pest is thought to be responsible for the population decline. Because of the

decline in numbers and the extremely poor nesting success, the Department of Agriculture officially closed the turtle-dove hunting season as of March 28, 1987. The season will be reopened if nesting success improves and numbers recover to a level that can support recreational hunting.

OBJECTIVES

1. To determine present population levels and distribution, and monitor population trends.
2. To investigate nesting success and causes of nest failures.

PROCEDURES

Call-count and roadside-count surveys were conducted at Northwest Field (NWF) and the Conventional Weapons Storage Area (CWA) on Andersen Air Force Base. Both surveys were conducted twice monthly in early morning. The call-count survey consisted of counting the number and species of doves seen or heard during a 5-minute period at 10 stations in NWF plus the number of doves seen enroute between stations. The roadside-count survey at CWA involved counting the number of Philippine Turtle-Doves seen while driving at 25 km per hour along an established 32 km route. The Philippine Turtle-Dove is also included in a twice monthly roadside-count of all birds conducted by DAWR Staff in 3 areas of northern Guam. The results of these surveys are reported in Job W-1-3.

Philippine Turtle-doves were additionally surveyed during spring game bird counts conducted on 23 routes throughout the island in June. These surveys consisted of 5-minute station counts at up to 10 stations per route with the number of birds seen or heard recorded at each station. Results are summarized as the average number of birds observed per station.

RESULTS

Population Surveys

Call count surveys and roadside counts were continued at NWF and the CWA on Andersen Air Force Base (Table 1). For the first time in three years, surveys on NWF were not significantly lower than the previous year (Mann Whitney U-Test, $n_1 = 24$, $n_2 = 22$, $U = 288$, $P = 0.40$, Sokal and Rolf 1981). The average count increased slightly (8%) from 22.5 birds/survey during FY 1987 (DAWR 1987) to 24.2 birds/survey during FY 1988. Numbers bottomed out in December 1987 and have increased steadily since then (Fig. 1). This may signify the end of the decline that this population has undergone over the past four years (Fig. 2).

Roadside counts in the CWA exhibited a similar trend (Figs. 3). The average number of birds observed per count declined slightly (4%) from 24.0 birds/count in FY 1987 to 23.1 birds/count in FY 1988 but numbers observed during FY 1988 were not significantly different from those observed during FY 1987 (Mann Whitney U-Test, $n_1 = 23$, $n_2 = 20$, $U = 235.5$, $P = 0.90$). Numbers reached a four-year low in February 1988 and have increased steadily since then (Fig. 4).

The native Mariana Fruit-Dove (*Ptilinopus roseicapilla*) and White-throated Ground-Dove (*Gallicolumba xanthonura*) were not recorded on either NWF or CWA survey during FY 1988. The fruit-dove has not been seen on either survey since FY 1985 and the ground-dove was last recorded on these surveys in FY 1986. However, one fruit-dove was heard and later sighted by DAWR staff in the vicinity of Andersen South in June 1988 while conducting a Spring Game Bird Survey and a ground-dove was sighted in Yigo during the same month.

Spring Game Bird Surveys

Turtle-doves were recorded on all 23 spring game bird surveys conducted during 1988 (Table 2). Snake free Cocos Island again had the highest count with an average of 6.57 birds observed per station. The CWA and NWF had the next highest counts with 2.70 and 2.20 birds/station, respectively. The Tarague, Mt. Santa Rosa, Navy Golf Course Barrigada, Reserve Craft Beach and Ija routes had station counts ≥ 1.0 bird/station. The largest increase in numbers occurred on the CWA route where the average station count increased 2.10 birds/station. Turtle-dove numbers appear to be increasing throughout the island. There was a significant increasing trend in the 23 routes surveyed over the past year. The number of doves observed per station increased on 15 routes, remained the same on 2 routes, and decreased on 6 routes. This increase throughout the island reflects a general trend that is statistically significant (Sign Test, $Z = 1.75$, $P = 0.08$, Sokal and Rolf 1981) rather than random fluctuations in local populations. The increasing trend was most consistent on the 11 routes in southern Guam. Numbers there increased on 8 routes, remained the same on 2 routes, and decreased on just 1 route, a statistically significant trend (Sign Test, $Z = 2.00$, $P = 0.05$). In northern Guam, numbers increased on 7 and decreased on 5 of the 12 routes.

RECOMMENDATIONS

1. Continue call count and roadside count surveys in northern Guam to monitor distribution, relative abundance and population trends of the Philippine Turtle-Dove.
2. Keep Philippine Turtle-Dove hunting season closed until nesting success improves and the population recovers.

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Report prepared by Paul J. Conry

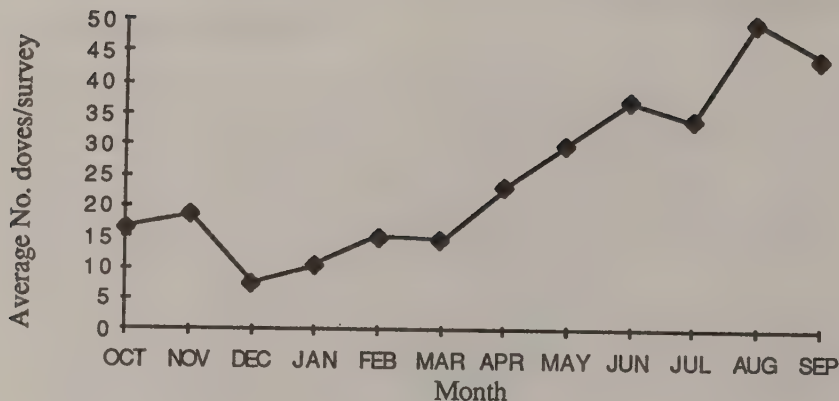


Figure 1. Average number of Philippine Turtle-Doves observed per survey on monthly station counts at Northwest Field, Andersen Air Force Base, Guam during FY 1988.

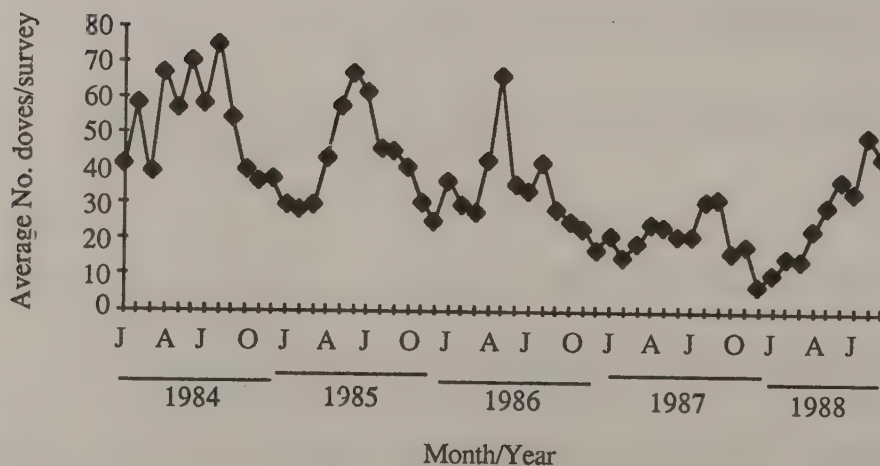


Figure 2. Average number of Philippine Turtle-doves observed per survey on monthly station counts at Northwest Field, Andersen Air Force Base, Guam during January, 1984 - September, 1988.

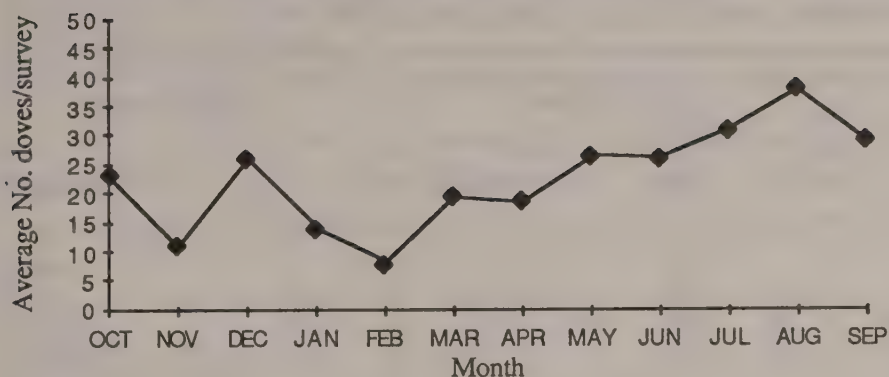


Figure 3. Average number of Philippine Turtle-Doves observed per survey on monthly roadside counts at the Conventional Weapons Area, Andersen Air Force Base, Guam during FY 1988.

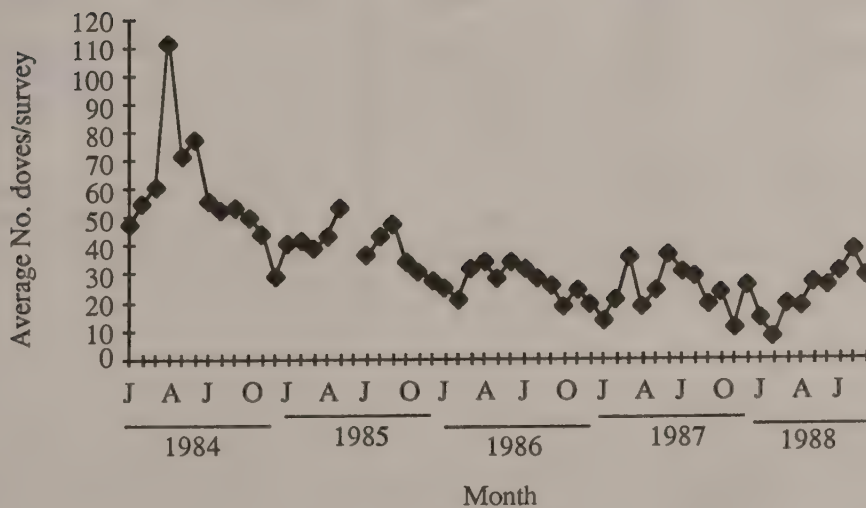


Figure 4. Average number of Philippine Turtle-Doves observed per survey on monthly roadside counts at the Conventional Weapons Area, Andersen Air Force Base, Guam during January, 1984 - September, 1988.

Table 1. Results of Philippine Turtle-Dove surveys at Northwest Field (NWF) and the Conventional Weapons Area (CWA) on Andersen Air Force Base, Guam during FY 1988.

Month	NWF Surveys				CWA Surveys		
	1	2	3	Average	1	2	Average
1987							
October	17	16		16.5	30	16	23.0
November	19	18	19	18.7	11		11.0
December	11	4		7.5	17	35	26.0
1988							
January	9	12		10.5	20	8	14.0
February	15			15.0	8		8.0
March	14	15		14.5	17	22	19.5
April	28	18		23.0	18	19	18.5
May	28	32		30.0	22	31	26.5
June	37			37.0	23	29	26.0
July	34			34.0	31		31.0
August	56	43		49.5	31	45	38.0
September	41	47		44.0	29		29.0
Survey Average				24.2			23.1

Table 2. Numbers of Philippine Turtle-Doves observed per count and average number of birds per station as detected in spring game bird surveys at various locations on Guam during June 1988. Values in the trend column are the difference between the average station count between years.

Survey Location	No. Stations	No. Doves Observed	1988 Ave./ station	1987 Ave./ station	Trend in Ave. 87-88
Tarague	8	10	1.25	0.60	0.65
CWA	10	27	2.70	0.60	2.10
NWF	10	22	2.20	2.50	-0.30
NAVCAMS	10	5	0.50	0.60	-0.10
Capitol Improvement Road	10	9	0.90	0.10	0.80
MT. Santa Rosa	8	11	1.38	1.33	0.04
Y Sengsong Road	10	4	0.40	0.20	0.20
Two Lovers Point	10	4	0.40	0.60	-0.20
Andy South	10	6	0.60	0.30	0.30
Navy Golf Course, Barrigada	10	12	1.20	1.90	-0.70
Barrigada Hill	7	2	0.29	2.00	-1.71
Toto Pipeline	8	4	0.50	0.25	0.25
Nimitz Hill	10	4	0.40	0.20	0.20
Reserve Craft Beach Road	4	4	1.00	0.25	0.75
Orote Point	6	3	0.50	0.50	0.00
Pulantat	10	5	0.50	0.89	-0.39
Cross Island Rd.	10	5	0.50	0.20	0.30
NAVMAG	10	7	0.70	0.10	0.60
Umatac	10	2	0.20	0.10	0.10
Dandan	10	6	0.60	0.10	0.50
Ija	6	9	1.50	1.00	0.50
Merizo	6	4	0.67	0.67	0.00
Cocos Island	7	46	6.57	6.30	0.27

**JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT**

STATE: Territory of Guam

PROJECT NO.: FW-2R-25
SUB-PROJECT NO.: W-2
STUDY NO.: 2
JOB NO.: 1

JOB TITLE: Preparation of a Status Report on Black Francolin.

PERIOD COVERED: October 1, 1987 to September 30, 1988.

OBJECTIVES

To prepare a status report on Black Francolin to be used in planning future work.

RESULTS

This project was inactive during Segment 25. Completion of the status report will be postponed until additional field work on movements and habitat use of francolin (Job W-2-2-3) can be completed and incorporated into the report. Job W-2-2-3 should be initiated during the Segment 26.

Report prepared by: Paul J. Conry

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: FW-2R-25
SUB-PROJECT NO.: W-2
STUDY NO.: 2
JOB NO.: 2

JOB TITLE: Population Size and Distribution of Black Francolin on Guam.

PERIOD COVERED: October 1, 1987 to September 30, 1988.

SUMMARY

Black Francolin were legally hunted during the months of January and July, 1988. An estimated 91 hunters spent 555 hunter-days hunting and harvested 723 birds, expending 0.77 hunter-days per bird taken. Bolanos and Cotal (Tarzan Falls) Territorial Conservation Reserves, Dandan, Ija, and Private property were reported as areas hunted. Black Francolin were found on 13 of 23 spring game bird surveys conducted throughout the island during June 1988. The average number of birds detected per station increased on 11 survey routes and decreased on 2 between 1987 and 1988. This pattern appears to reflect a significant (Sign Test, $Z = 2.22$, $P = 0.01$) increasing trend rather than random fluctuations in local populations. Francolin occurred on all 11 surveys south of Route 4 with the exception of Cocos Island. In addition, francolin are now found north of Route 4 in shrub-grass habitat in the vicinity of Naval Air Station, Barrigada, and NAVCAMS. The Ija area had the highest station counts of any survey on the island with an average of 8.0 birds/station detected during the 1988 survey. It also had the largest relative increase in birds with the average station count increasing 2.6 birds/station. The Pulantat, Merizo, Dandan, Cross Island Rd., and Umatac routes also had high (> 6.0 birds/station) average station counts. Francolin populations are well established throughout southern Guam and appear able to sustain the current levels of recreational hunting.

BACKGROUND

In 1961, 171 Black Francolin (*Francolinus francolinus*) were introduced in southern Guam as part of the Foreign Game Bird Introduction Program of the U.S. Fish and Wildlife Service. Surveys conducted in 1980 indicated the population was adequately established in most parts of southern Guam to open a hunting season. Regulations were promulgated to open a 1-month season in December 1981 with a 4 bird daily limit and a 20 bird season limit. Francolin populations continued to increase from 1980-1982 but hunting pressure remained low, probably because of the unfamiliarity of the hunting public with the sporting qualities of the bird. With the bird population consistently increasing and little hunting pressure, the francolin season and bag limits were further liberalized in FY 1983 to a 2 month-split season, 1 month in January and 1 month in July, and the bag limit was increased to 5 birds per day with no season limit. Francolin hunting has increased in popularity and Guam hunters are successfully harvesting birds during the open seasons. Regulations implemented in FY 1983 remain in effect with hunter participation and

adherence to game laws monitored by spot checks by Division biologists and conservation officers.

OBJECTIVES

To determine current relative abundance and current distribution of Black Francolin on Guam and monitor population trends and hunter harvest.

PROCEDURES

1. Conduct annual island-wide spring game bird surveys (station counts) to monitor distribution and status of francolin throughout the island.
2. Conduct twice weekly station-count surveys during May-June to monitor pre-hunting season status of francolin population in Dandan, Inarajan.
3. Monitor hunter harvest via an annual harvest questionnaire. Collect information on hunter participation, effort, harvest, and areas hunted.

RESULTS

Francolin Hunting Statistics

License sales increased 18% in FY 1988 with 620 licenses sold during the year (Table 1). All license holders were mailed a harvest questionnaire and responses were obtained from 135 persons (22%). Eighty-one percent of the respondents indicated they had hunted at some time during the season. Based on that percentage, an estimated 505 persons legally hunted game during the year, an increase of 43% over FY 1987 levels.

Eighteen percent of the responding hunters reported they hunted francolin during the license year, 13% during the January season, 15% during the July season (Table 1). Hunter success was 86% in January, 94% in July and 95% for the year. The hunters that responded to our questionnaire took an average of 5.14 birds in January, 5.44 birds in July and 7.95 birds overall.

Francolin hunters expended an average of 4.6, 3.6, and 6.1 days hunting in January, July, and over the entire season, respectively. The hunting effort expended per bird harvested was 0.90 days/bird in January, 0.66 days/bird in July, and 0.77 days/bird overall.

Estimates of total hunter participation, effort, and harvest were based on hunter questionnaires. In FY 1988, an estimated 91 hunters spent 555 hunter days and harvested 723 birds over the entire season. In contrast, 72 hunters spent 310 days hunting and harvested 360 birds in FY 1987. The hunter statistics for FY 1988 indicated an increase in hunter participation of 26%, an increase in hunter effort of 79%, and an increase in harvest of 101% over FY 1987 levels.

Bolanos and Cotal (Tarzan Falls) Territorial Conservation Reserves, Dandan, Ija, and private property were identified as areas hunted this past year. Two hunters (10%) reported they hunted with a bird dog.

Although the data indicated an increase in hunter activity this past season, the estimated total effort and harvest seemed far higher than actual activity and are likely over-estimates of hunter activity. These results reflect the bias typical of hunter questionnaires where successful hunters are far more likely to report their activities than unsuccessful ones. Consequently, information derived from this questionnaire is more useful as an index of hunter activity rather than an absolute estimate of it.

Spring Game Bird Surveys

Black Francolin were detected on 13 of 23 spring game bird surveys conducted during June 1987 (Table 2). Francolin were found on all of the 11 surveys south of Route 4 with the exception of the Cocos Island survey. For the second year in a row, francolin were located at an additional survey site north of Route 4, at NAVCAMS. Francolin can now be found in the scrub-grass habitat in the vicinity of the Agana Naval Air Station, the antenna fields in the NAVCAMS Barrigada area, and antenna field at NAVCAMS.

The Ija area had the highest station counts with an average of 8.0 birds/station. The Ija route also had the highest relative increase in birds with the average station count increasing 2.6 birds/station. The Pulantat, Merizo, Dandan, Cross Island Rd., and Umatac routes also had high (> 6.0 birds/station) average station counts. The average number of birds detected per station increased on 11 survey routes and decreased on 2 between 1987 and 1988. This pattern appears to reflect a significant (Sign Test, $Z = 2.22$, $P = 0.01$, Sokal and Rolf 1981) increasing trend rather than random fluctuations in local populations. The Ija, Dandan, Merizo, Cross Island Road, Umatac, Navy Golf Course-Barrigada, and Orote Point routes had increases ≥ 1.0 birds/station. Francolin populations remain well established and stable throughout southern Guam and appear to be expanding their range into some shrub-grass habitats in central and northern Guam.

RECOMMENDATIONS

1. Continue to monitor francolin population status, distribution, and hunter harvest.
2. Increase the response rate of annual hunter questionnaire.

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Report prepared by Paul J. Conry

Table 1. Black Francolin (BLFR) harvest statistics for FY 1988.

	Jan 88	Jul 88	Total
a. Total license sales for year			620
b. Hunter questionnaires mailed out.....			620
c. Number of hunter questionnaires returned			135
d. Percent of license buyers reporting.....			21.8%
e. Number of respondents (135) that hunted any species			110
f. Percent of license buyers that hunted			81.5%
g. Estimated total number of legal hunters.....			505
h. Number of reporting hunters that hunted BLFR	14	16	20
i. Percent of reporting hunters that hunted BLFR.....	13%	15%	18%
j. Number of successful BLFR hunters.....	12	15	19
k. Hunter success.....	86%	94%	95%
l. Number of BLFR taken by reporting hunters.....	72	87	159
m. Average number of BLFR taken per hunter.....	5.14	5.44	7.95
n. Average number of BLFR taken per successful hunter.....	6.0	5.8	10.26
o. Reported number of days spent hunting.....	64	57	121
p. Average number of days spent hunting.....	4.6	3.6	6.1
q. Estimated total number of legal BLFR hunters	66	76	91
r. Estimated total legal BLFR harvest.....	339	413	723
s. Estimated total number of days spent hunting	304	274	555
t. Number of days spent hunting per BLFR taken.....	0.90	0.66	0.77
u. Number of BLFR taken per day hunting	1.11	1.51	1.30

Table 2. Numbers of Black Francolin (BLFR) observed per count and average number of birds observed per station as detected in spring game bird surveys at various locations on Guam during June 1988. Values in the trend column are the difference between the average station count between years.

Survey Location	No. Stations	No. Birds Observed	1988 Ave./ station	1987 Ave./ station	Trend in Average 87-88
Tarague	8	0	0.00	0.00	0.00
CWA	10	0	0.00	0.00	0.00
NWF	10	0	0.00	0.00	0.00
NAVCAMS	10	1	0.10	0.00	0.10
Capitol Improvement Road	10	0	0.00	0.00	0.00
MT. Santa Rosa	8	0	0.00	0.00	0.00
Y Sengsong Road	10	0	0.00	0.00	0.00
Two Lovers Point	10	0	0.00	0.00	0.00
Andy South	10	0	0.00	0.00	0.00
Navy Golf Course-Barrigada	10	24	2.40	0.90	1.50
Barrigada Hill	7	7	1.00	0.29	0.71
Toto Pipeline	8	0	0.00	0.00	0.00
Nimitz Hill	10	45	4.50	4.70	-0.20
Reserve Craft Beach Road	4	1	0.25	0.00	0.25
Orote Point	6	23	3.83	2.50	1.33
Pulantat	10	72	7.20	7.67	-0.47
Cross Island Rd.	10	62	6.20	4.50	1.70
NAVMAG	10	38	3.80	3.30	0.50
Umatac	10	61	6.10	4.50	1.60
Dandan	10	66	6.60	4.20	2.40
Ija	6	48	8.00	5.40	2.60
Merizo	6	42	7.00	5.00	2.00
Cocos Island	7	0	0.00	0.00	0.00

**JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT**

STATE: Territory of Guam

PROJECT NO.: FW-2R-25
SUB-PROJECT NO.: W-2
STUDY NO.: 2
JOB NO.: 3

JOB TITLE: Territory Size, Movement Patterns and Habitat Utilization of the Black Francolin.

PERIOD COVERED: October 1, 1987 to September 30, 1988.

OBJECTIVES

To determine movement patterns, territory size and habitat use of the Black Francolin.

RESULTS

This project was inactive during Segment 25 because of manpower constraints. The radio-telemetry portion of this job should be initiated during Segment 26 and data obtained during the study incorporated into the status report and species management plan (Job W-2-2-1).

Report prepared by: Paul J. Conry

GUAM ENDANGERED SPECIES INVESTIGATIONS
PROJECT E-1-3
Section 6 - Endangered Species Act of 1973

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: E-1-3
STUDY NO.: 4
JOB NO.: 1

JOB TITLE: Captive Breeding Endangered Native Birds.

PERIOD COVERED: October 1, 1987 to September 30, 1988.

SUMMARY

During FY1988 the number of Guam Rails at the DAWR facility increased from 20 to 37. The captive rail population at mainland U.S. zoos increased to more than 113. The Guam Micronesian Kingfisher population in captivity at mainland U.S. zoos, remained stable. Construction began to enlarge the DAWR rail facility. The kingfisher was designated an American Association of Zoological Parks and Aquariums (AAZPA) Species Survival Program species.

BACKGROUND

The Guam Native Forest Bird Captive Breeding Program began in 1983 as a cooperative effort between the Division of Aquatic and Wildlife Resources (DAWR), member zoos of the American Association of Zoological Parks and Aquariums (AAZPA) and the U.S. Fish and Wildlife Service (DAWR 1983, Derrickson 1986, Shelton 1986). Predation by the brown tree snake, *Boiga irregularis*, now believed to be the single most important factor in the recent drastic decline of Guam's native forest birds (Savidge 1986, 1987; Conry 1988), precipitated the need for a captive breeding program when by 1982 at least five species of Guam endemic species or subspecies were nearing extinction in the wild. Unfortunately by 1984, attempts at captive breeding three of these species, the Bridled White-eye, *Zosterops c. conspicillata*, Rufous Fantail, *Rhipidura rufifrons uraniae*, and the Guam Flycatcher, *Miagra freycineti*, were abandoned due to their virtual disappearance from the wild (DAWR 1984).

The Guam Rail, *Rallus owstoni*, and Guam subspecies of the Micronesian Kingfisher, *Halcyon c. cinnamomina*, were successfully brought into captivity (DAWR 1983-6), with the capture of 19 and 31 founder birds respectively. Rails first bred at the DAWR's facility on Guam and at the Conservation and Research Center (CRC) of the National Zoological Park in 1984. Kingfishers were first bred at three mainland U.S. zoos (Bronx Zoo, Philadelphia Zoo and the Conservation and Research Center of National Zoological Park) in 1985. By September 30 1987, there were approximately 101 rails and 49 kingfishers in captivity on Guam and at mainland U.S. Zoos.

OBJECTIVES

Implement and manage a captive breeding program for the Guam Rail and other endangered endemic birds by setting up facilities on Guam and at zoos on the mainland U.S. with the assistance of member zoos of the AAZPA.

PROCEDURES

1. Continue the development of a cooperative captive breeding program for the Guam Rail and Micronesian Kingfisher with the AAZPA and its member zoos.
2. Upgrade and enlarge the Guam Rail breeding facility at DAWR office in Mangilao to allow up to 100 birds to be held in captivity.
3. Develop techniques for the successful release of captive-reared birds in the wild once the factors responsible for their decline have been controlled.
4. Conduct study into the breeding biology in the field on Guam of birds that are to be captive bred.
5. Continue to consult with recognized authorities regarding captive breeding methodology, facility designs, and captive population management techniques.
6. Consult and coordinate with U.S. Fish and Wildlife Service, U.S. Department of Agriculture, and other government agencies with jurisdiction over the interstate movement and captive maintenance of wildlife. Acquire all necessary local and federal permits.

RESULTS

The number of Guam Rails at the DAWR's facility on Guam increased from 20 on October 1, 1987 to 37 by September 30, 1988. A total of 9 chicks were hatched from 5 clutches. There were 6 and 5 rails respectively transferred to Guam from the CRC on May 25 and August 26, 1988. Finally, 3 rails were transferred from Guam to the CRC on June 5, 1988. There were no rail fatalities at the Guam facility during FY 1988.

There are now more than 150 rails in captivity both on Guam and at the following 12 mainland U.S. Zoos (Fig. 1):

1. Conservation and Research Center, National Zoological Park, Washington, D. C.
2. Bronx Zoo, New York Zoological Society, Bronx, New York
3. Philadelphia Zoological Garden, Philadelphia, Pennsylvania
4. Pittsburg Aviary, Pittsburg, Pennsylvania
5. Kansas City Zoo, Kansas City, Missouri
6. River Banks Zoo, Charleston, South Carolina
7. San Diego Zoo, San Diego, California
8. Lowery Park Zoo, Tampa, Florida
9. Sedgwick Zoo, Kansas
10. Baton Rouge Zoological Park, Baton Rouge, Louisiana
11. Trevor Park Zoo, New York
12. Miami Metro Zoo, Miami, Florida

During FY 1988 contracts were issued and construction began on 22 steel framed typhoon resistant breeding aviaries at the DAWR's rail captive breeding facility in Mangilao which

when completed will enlarge the capacity from 48 to 100 rails. These will replace the original wooden framed aviaries that were rapidly deteriorating from weathering and typhoon wind damage.

Drs. Scott Derrickson and Lyndsay Phillips from the CRC visited Guam in late May and instructed a local veterinarian and our wildlife staff on a method for sexing the Guam Rail by using a surgical laproscope procedure. In addition, they reviewed protocols for feeding, and prevention of disease at our facility.

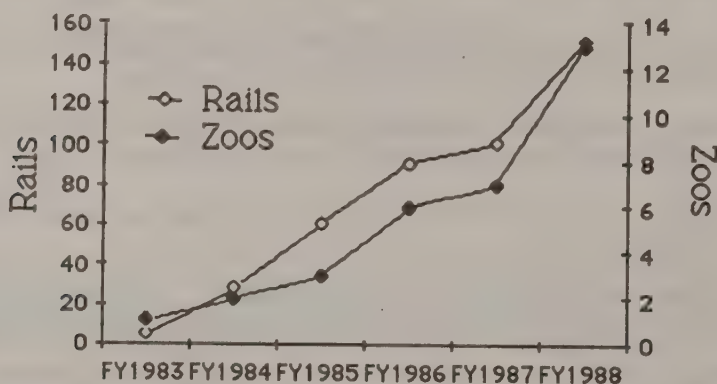


Figure 1: The number of Guam Rails and breeding facilities (mainland zoos plus the DAWR facility) participating in the Guam Native Forest Bird Captive breeding Program during fiscal years 1983-1988.

Plans continue to introduce the Guam Rail to Rota during FY 1989. A report on activities to date for this project appears elsewhere in this annual report under "Rota Experimental Population" (DAWR 1988).

During FY 1988, 14 Micronesian Kingfisher chicks were hatched with 7 surviving to fledging at mainland U.S. zoos participating in our captive breeding program under the auspices of the AAZPA. In addition, 14 kingfishers died in captivity (including the chicks mentioned above). Especially significant was the hatching at the San Antonio Zoo on July 2, 1988 of the first second generation kingfisher chick from parents who were themselves hatched in captivity.

As of September 13, 1988 there were a total of 48 Micronesian Kingfishers in captivity at the following 12 mainland U.S. zoos (Bahner 1988) (Fig. 2):

1. Conservation and Research Center, National Zoological Park, Washington, D. C.
2. Bronx Zoo, New York Zoological Society, Bronx, New York
3. Philadelphia Zoological Garden, Philadelphia, Pennsylvania
4. Pittsburg Aviary, Pittsburg, Pennsylvania
5. Kansas City Zoo, Kansas City, Missouri
6. River Banks Zoo, Charleston, South Carolina
7. St. Louis Zoo, St. Louis, Missouri
8. San Antonio Zoo, San Antonio, Texas
9. Brookfield Zoo, Chicago, Illinois
10. Cincinnati Zoo, Cincinnati, Ohio

During FY 1988 a studbook for the Micronesian Kingfisher was published by the Philadelphia Zoo (Bahner 1988). The kingfisher was officially designated as a Species Survival Program species by the AAZPA. Larry Shelton, Curator of Birds at the Houston Zoo was named Species Coordinator and Beth Bahner of the Philadelphia Zoo will continue as studbook keeper.

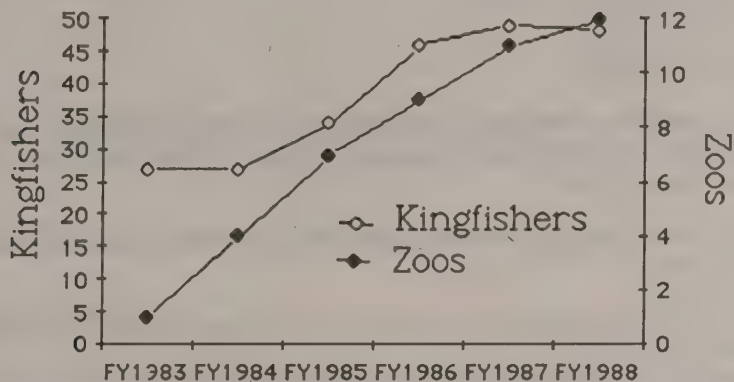


Figure 2- The number of Guam Micronesian Kingfishers and mainland zoos participating in the Guam Native Forest Bird Captive Breeding Program during fiscal years 1983-1988.

Larry Shelton was also named as the overall coordinator for the AAZPA's participation in the Guam Native Forest Bird Captive Breeding Program. Dr. Scott Derrickson, Curator of Birds, Conservation and Research Center, National Zoological Park, Smithsonian Institution, Front Royal, Virginia is continuing as coordinator for AAZPA's Guam Rail program.

RECOMMENDATIONS

1. Complete the enlargement the Guam Rail breeding facility at the DAWR office in Mangilao to allow up to 100 birds to be held in captivity in order to support the introduction of the Guam Rail to Rota Island beginning in 1989.
2. Develop plans and seek funding for the construction of a building to support food preparation areas, incubator and brooding equipment usage and storage of supplies and equipment.
3. Develop plans for and seek funding for construction of at least six 12 stall holding aviaries to replace existing wooden aviaries that have deteriorated from weather and typhoons.
4. Continue development of a cooperative captive breeding program for the Guam Rail and Micronesian Kingfisher with the AAZPA and it's member zoos.
5. Continue to consult with recognized authorities regarding captive breeding methodology, facility design, and captive population management techniques.

6. Seek funding for transport of birds to zoos for captive breeding from conservation groups and other private sources.
7. Consult and coordinate with U.S. Fish and Wildlife Service, U.S. Department of Agriculture, and other government agencies with jurisdiction over the interstate movement and captive maintenance of wildlife. Acquire all necessary local and federal permits.

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Report prepared by: Robert E. Beck, Jr.

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: E-1-3

STUDY NO.: 4

JOB NO.: 2

JOB TITLE: Development of an Experimental Population of Guam Rails on Cocos Island or in the Commonwealth of the Northern Mariana Islands.

PERIOD COVERED: October 1, 1987 to September 30, 1988

SUMMARY

Planning and implementation of preintroduction activities continued for the introduction of the Guam Rail to Rota in the Commonwealth of the Northern Marianas Islands (CNMI). The introduction originally planned for the Summer of 1988 was postponed until FY 1989 because of federal permitting delays.

BACKGROUND

Since the creation in 1960 of the Guam Division of Aquatic and Wildlife Resources (DAWR), census data from roadside counts, station counts, and transect counts have documented the reduction in range and numbers of the Guam Rail, *Rallus owstoni*, and other native birds (DAWR 1961-1987; Jenkins 1983; Engbring and Ramsey 1984). Predation by the brown tree snake, *Boiga irregularis*, is believed to be the major factor contributing to recent declines in native bird populations (Savidge 1986, 1987; Conry 1988). Research efforts are presently underway to develop methods for controlling rail predation by the brown tree snake. However, it is not likely that we will be able to adequately control snake predation on Guam so that we will be able to introduce the rail back into the wild there in the near future .

A captive breeding program for the Guam Rail was successfully begun in 1983 on Guam and at mainland U.S. zoos in cooperation with the American Association of Zoological Parks and Aquariums (DAWR 1984-1987; Derrickson 1986). Guam Rails were first brought into captivity in 1983 on Guam and bred at the DAWR's rail facility in the spring of 1984 (DAWR 1983-4). By September 1987 there were more than 101 rails in captivity on Guam and at stateside zoos.

The DAWR is developing plans to introduce the Guam Rail to Rota in order to develop a self sustaining wild population of rails that will not undergo "domestication" from captive breeding. It is hoped that the experience gained in introducing the rails to Rota will provide valuable information useful for future introductions on Guam. The Rota population may also serve as a partial source of birds for use in reintroducing the rail to Guam when snake predation has been controlled there.

During FY 1987 a cooperative agreement was signed between the Government of Guam, Commonwealth of the Northern Mariana Islands (CNMI), and the U.S. Fish and Wildlife Service (USFWS) outlining the responsibilities of each entity for the introduction. An environmental assessment was prepared for the USFWS covering the introduction of the Guam Rail to Rota and forwarded to Environmental Services, USFWS, Honolulu. Upon review it was mutually decided to additionally conduct an insect and reptile survey of Rota to discover the presence of possible endangered species. Dr. Stuart Pimm, Professor of Zoology, University of Tennessee and the DAWR reached agreement by which a graduate student from the University of Tennessee will be resident on Rota for at least three years monitoring the rail introduction in cooperation with the DAWR as a part of his dissertation research. In addition, Dr. Pimm, with the support of the DAWR, applied for research grants to support the monitoring study. In April, 1987, Robert Beck from the DAWR and Dr. Pimm, accompanied by Phil Glass from the CNMI Fish and Wildlife Division, visited Rota for the purpose of investigating possible sites for the introduction. Sites in Palii and Sinapolo were tentatively selected. In addition, visits were made to various Rota government officials to update them as to the status of the project.

PROCEDURES

1. Finalize permits required for the introduction from the Commonwealth of the Northern Mariana Islands and the U.S. Fish and Wildlife Service.
2. Captive breed Guam Rails needed for the introduction on Guam and at mainland U.S. zoos.
3. Develop techniques and methods for introduction of the rail to Rota.
4. Conduct surveys for reptiles and insects on Rota for purposes of locating possible endangered species.
5. Construct necessary holding facilities on Rota at the site of the release.
6. Seek assistance of the Navy in transporting rails from DAWR captive breeding facility to release site on Rota.
7. Conduct public information meeting on Rota prior to introduction of rails.
8. Implement disease prevention protocol with rails on Guam prior to release on Rota.
9. Implement the introduction of the Guam Rail to Rota during the summer of 1988 or as soon after as feasible.
10. In cooperation with Dr. Stuart Pimm and his graduate student, monitor the success of the initial introduction of Guam Rails to Rota and continue with successive introductions to the island as warranted.
11. Continue to seek funding from conservation organizations to support the monitoring of the introduced rail population on Rota.

RESULTS

Captive breeding of the Guam Rail continued at the DAWR captive breeding facility and mainland U.S. zoos with the captive population now numbering over 150 rails. Contracts

for construction of 22 additional rail breeding aviaries on Guam were let and completion is expected early in the 1989 fiscal year.

A survey of Rota for reptiles was conducted by Gary Wiles, DAWR, and Drs. Gordon Rodda, and Thomas Fritts, of the USFWS in the fall of 1987. Drs. Muniappan and Marutani of the University of Guam conducted an insect survey of Rota in February 1988. The results of both surveys, which found no endangered species, were submitted to the USFWS, Honolulu for inclusion in the Environmental Assessment for the project.

In May, 1988, Dr. Scott Derrickson, Curator of Birds and the National Zoological Park and Robert Beck visited Rota looking for additional possible introduction sites. A site on the Sabanna was selected for the initial introduction. Dr. Derrickson also transported rails to Guam to broaden the genetic variation of the Guam captive population in preparation for breeding birds for release on Rota.

In June, 1988, staff of the DAWR, with the assistance of the Rota Department of Natural Resources, constructed three 12-stall holding aviaries at the Sabana introduction site.

Radio telemetry equipment to be used to monitor the success of the introduction was purchased by the DAWR.

Dr. Stuart Pimm of the University of Tennessee was successful in receiving several grants from international conservation organizations to support his efforts in monitoring the introduction on Rota with graduate student, Greg Witteman. Using these funds, a 1/2 ton pickup truck was purchased on Rota for use by the staff monitoring the introduction.

In July we were informed by the U.S. Fish and Wildlife Service that there would be a delay in publication of the Final Rule required for designating the experimental population status of the rails released on Rota that would delay the introduction into FY 1989.

Conservation organizations were notified of the delay so that coordination of their funding could be arranged to not cause delay of implementation of the monitoring project when the actual introduction takes place.

RECOMMENDATIONS

1. Finalize permits required for the introduction from the Commonwealth of the Northern Mariana Islands and the U.S. Fish and Wildlife Service.
2. Captive breed Guam Rails needed for the introduction on Guam and at mainland U.S. zoos.
3. Continue to develop techniques and methods for introduction of the rail to Rota.
4. Seek assistance of the Navy in transporting rails from DAWR captive breeding facility to release site on Rota.
5. Conduct public information meeting on Rota prior to introduction of rails.
6. Implement disease prevention protocol with rails on Guam prior to release on Rota.

7. Implement the introduction of the Guam Rail to Rota as soon as Final Rule for designation of an experimental population is published.
8. In cooperation with Dr. Stuart Pimm and his graduate student, monitor the success of the initial introduction of Guam Rails to Rota and continue with successive introductions to the island as warranted.
9. Continue to seek funding from conservation organizations to support the monitoring of the introduced rail population on Rota.

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Report prepared by: Robert E. Beck, Jr.

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: E-1-3

STUDY NO.: 5

JOB NO.: 1

JOB TITLE: Native Bird Status Surveys and Natural History.

PERIOD COVERED: October 1, 1987 to September 30, 1988

SUMMARY

Roadside count data continues to document the decline of Guam's native forest birds. Introduced birds showed some increase in the North and North-Central roadside counts. The Black Francolin was observed for the first time in northern Guam on the North-Central Roadside count. Northwest Field (NWF) and Conventional Weapon Storage Area (CWSA) on Anderson Air Force Base (AAFB) remain the center of distribution for most of Guam's remaining forest birds. Fena lake appears to be the most important wetland for the Mariana Common Moorhen on Guam. Guam's Island Swiftlet population, known only from a single cave in central Guam, declined from approximately 450 birds to 250 over a two month period in June and July.

BACKGROUND

Since the early 1960's, census data has documented the decline in both range and numbers of Guam's native land birds. Roadside counts initiated in 1960 over four routes in southern, central and northern Guam by the Guam Division of Aquatic and Wildlife Resources (DAWR) have provided an index to the decline (DAWR, 1974-1987). From 1979 to 1981 estimates of the population trends were made by the DAWR based on variable circular-plot techniques (Reynolds et al. 1980) and from station counts in central and northern Guam (DAWR 1980-1982). From June to July of 1981, an intensive forest bird survey utilizing variable-circular plot techniques along randomly located transects was conducted by the U.S. Fish and Wildlife Service with the cooperation of the DAWR (Engbring and Ramsey, 1984). Some of these transects have been repeated in recent years by the DAWR (1982-1987). In 1987, surveys for the Mariana Common Moorhen at Fena Lake and the Island Swiftlet

Native land birds are now primarily restricted to northern Guam with the center of distribution of remaining native forest birds located on Northwest Field and Conventional Weapons Area at AAFB. Exceptions are the Island Swiftlet (known only from one cave in central Guam), Mariana Common Moorhen (found over most of Guam in restricted and declining wetlands), Micronesian Starling (found on Cocos Island, southeast coast and various urban areas), and the Yellow Bittern (declining but found in savannah and second-growth vegetation over the entire island) (DAWR 1974-1987).

Predation by the brown tree snake, *Boiga irregularis*, is believed to be the major factor contributing to recent declines in Guam's native bird populations (Conry 1988; Savidge 1986, 1987).

A captive breeding program for the Guam Rail and Guam subspecies of the Micronesian Kingfisher was successfully begun in 1983 on Guam and at mainland U.S. zoos in cooperation with the American Association of Zoological Parks and Aquariums (DAWR 1984-1987; Derrickson 1986; Shelton 1986).

OBJECTIVES

To continue status surveys and natural history studies as called for in the Recovery Plans for Guam's various endangered native birds.

PROCEDURES

1. Roadside counts were conducted at bi-weekly intervals on three routes in northern Guam (Figure 1) by DAWR Conservation Officers. These routes were driven at approximately 6-9 km per hour beginning at sunrise. Numbers and species of all birds seen or heard were recorded, irrespective of the distance from the observer.
2. A survey for Mariana Common Moorhen at Fena Reservoir, U.S. Naval Magazine was conducted monthly beginning in February 1987. Three observers began each survey at dawn on upper Fena Reservoir using a canoe. They moved along the entire shoreline of the lake noting all moorhen seen or heard. Typically the survey took 4 to 5 hours to complete. The observers moved as far upstream the tributaries as was possible with a canoe.
3. During August, an island-wide wetland survey was initiated. With the use of National Wetland Inventory maps and an aerial survey of central and southern Guam, wetlands were photographed and plotted on topographic maps. Surveys, which are still being conducted, are made at these wetlands to record their approximate size, wetland and surrounding vegetation, topography and the presence of moorhen. It is planned to repeat this survey during the dry season of FY89 to determine which wetlands are seasonal and/or persistent. Wetlands currently utilized by the moorhen are in both urban and rural settings and are either man-made or natural. Results of this survey will be reported in FY 1989.
4. Monthly counts of Island Swiftlets were conducted at the swiftlet cave near Firebreak 4 on Naval Magazine. Observers sat at both entrances of the cave for a period of 2-2.5 hours before dark and recorded the numbers of birds flying in and out. The total number of birds inhabiting the cave was determined by subtracting the number of departures from the number of arrivals and by adding the number of birds estimated to be in the cave at the start of the count. Prior to each count, observers entered the cave for 0.5-1 hour to look for evidence of nesting and reproductive activity. The presence of nestlings and their calls and the incidence of adult birds that appeared to be incubating eggs or brooding young was noted. In order to avoid disturbing nesting birds, nests were viewed from a slightly elevated position off to the side of the cave rather than by lifting a mirror up to look inside the nests. The cave floor was searched and cleaned each month of eggshell fragments and whole eggs that had fallen from nests overhead.

RESULTS

Roadside counts done on the North, North-Central and Northwest Field routes in northern Guam (Figure 1) continued to document the status of native forest birds. Tables 1, 3 and 5 contain the data collected monthly during Fiscal Year 1988. Table 7 is a summary of the entire fiscal year's data for all three routes. Tables 2, 4 and 6 contain a comparison of Fiscal Year 1988 with the previous four years data for each roadside count route.



Figure 1- Map of Guam showing the location of Roadside Counts, Fena Lake Moorhen Survey and Island Swiftlet Cave.

On the North roadside count (Table 1) only 5 species were counted. Four were resident birds and they remained fairly constant in numbers over the year. No native forest birds were observed in FY 1988. Black Drongos continued to decline. Philippine Turtle-Doves and Eurasian Tree Sparrows continued to show an increase begun in FY 1985. Table 2, with yearly average data from 1984 to 1988, shows the remaining native forest birds disappearing (Mariana Crow, White-Throated Ground-Dove, Cardinal Honeyeater, Micronesian Kingfisher, Micronesian Starling) or declining (Yellow Bittern). Over this five year period the introduced drongo declined, the Philippine Turtle-Dove declined then increased while the Eurasian Tree Sparrow fluctuated, finally increasing in numbers by 1988.

Table 1. Average number of birds per 100 Km observed each month on the North roadside counts during Fiscal Year 1988.

Species	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Total	X/ct.	X/100 km
Yellow Bittern		2	2	1	1	1	2	5	2		1		17	0.74	1.95
Mariana Crow															
Black Drongo	6	5	13	1	4	3	10	13	14	7	4	6	96	3.74	9.85
Rufous-fronted Fantail															
Mariana Fruit-Dove															
Guam Broadbill															
Golden Plover	52	87	93	55	57	63	47	6				26	486	21.13	55.67
Wh-throated Grould-Dove															
Cardinal Honeyeater															
Micronesian Kingfisher															
Noddy Tern															
P.T. Dove	3	14	13	8	4	3	8	13	10	6	1	6	89	3.87	10.19
Chinese Painted Quail															
Guam Rail															
Chestnut Mannikin															
Eurasian Tree Sparrow	2	8	8	6	3	11	9	18	13	3		5	86	3.74	9.85
Micronesian Starling															
White Tern															
Km	77.1	75.2	11.1	74.0	79.0	63.0	79.0	78.4	115.6	39.0	39.0	4.00	873.0		
Miles	47.9	46.7	69.0	46.5	49.1	39.2	49.0	48.0	71.0	24.0	24.0	25.0	542.0		
Counts	2	2	3	2	2	2	2	2	3	1	1	1	23		

Table 2. Average number of birds per 100 Km observed each fiscal year on the North roadside counts between 1984 and 1988.

Species	FY1984	FY1985	FY1986	FY1987	FY1988
Yellow Bittern	4.20	2.30	2.06	2.41	1.95
Mariana Crow	0.30	0.40	0.10		
Black Drongo	23.70	12.20	13.22	10.35	9.85
Rufous-fronted Fantail					
Mariana Fruit-Dove					
Guam Broadbill					
Golden Plover	66.00	49.10	65.12	54.06	55.67
White-throated Ground-Dove			0.20		
Cardinal Honeyeater		0.10			
Micronesian Kingfisher		0.10			
Noddy Tern					
P.T. Dove	9.90	6.30	8.13	9.27	10.19
Chinese Painted Quail					
Guam Rail					
Eurasian Tree Sparrow	6.60	5.00	8.91	7.59	9.85
Micronesian Starling			0.88		
Bridled White Eye					
White Tern		0.50		0.36	
Black Francolin					

Seven species were observed on the North-Central count (Table 3). One, the Yellow Bittern, is native; another, the Pacific Golden Plover, is migratory; and the other five, the Black Drongo, Philippine Turtle-Dove, the Chestnut Mannikin, the Eurasian Tree Sparrow and the Black Francolin are introduced residents. The five year data shown on Table 4 found the Black Francolin, which was originally introduced to southern Guam in 1961 appearing, for the first time. It was first observed on this count route in April, 1988 continuing it's movement northward in grassland habitat. Six species of native forest birds disappeared from this route during this period (Mariana Crow, Rufous-fronted Fantail, Mariana Fruit Dove, Cardinal Honeyeater, Micronesian Kingfisher, Micronesian

Table 3. Average number of birds per 100 Km observed each month on the North-Central roadside counts during Fiscal Year 1988.

Species	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Total	X/Ct	X/100Km
Yellow Bittern		1	1	1		3			3	1	1	3	14	0.61	3.10
Mariana Crow															
Black Drongo	19	6	12	11	13	10	8	2	24	6	1	6	118	5.13	26.14
Rufous-fronted Fantail															
Mariana Fruit-Dove															
Guam Broadbill															
Golden Plover	266	334	410	331	167	175	67	6				38	1794	78.00	397.40
Wh-throated Ground-Dove															
Cardinal Honeyeater															
Micronesian Kingfisher															
Noddy Tern															
P.T. Dove	63	6	16	8	4	17	7	5	26	6	2	2	162	7.04	35.89
Chinese Painted Quail															
Guam Rail															
Chestnut Mannikin					1				7				8	0.35	1.77
Eurasian Tree Sparrow	11	5	12	5	9	11	7	8	5		2	4	79	3.43	17.50
Micronesian Starling															
White Tern															
Black Francolin				2		3	2	8	16	12	1		44	1.91	9.75
Km	36.7	37.3	57.8	38.1	50.9	39.1	39.3	38.6	56	19	19.3	19.3	451.4		
Miles	22.8	23.2	35.9	23.7	31.6	24.3	24.4	24	34.8	11.8	12	12	280.5		
Counts	2	2	3	2	2	2	2	2	3	1	1	1	23		

Table 4. Average number of birds per 100 Km observed each fiscal year on the North-Central roadside counts between 1984 and 1988.

North Central: Ave./100km	FY1984	FY1985	FY1986	FY1987	FY1988
Yellow Bittern	6.70	2.40	3.22	5.04	3.10
Mariana Crow	2.00		0.76	0.88	
Black Drongo	44.38	30.90	25.57	22.14	26.14
Rufous-fronted Fantail	0.40				
Mariana Fruit-Dove	0.20				
Guam Broadbill					
Golden Plover	362.69	240.80	483.27	437.92	397.40
White-throated Ground-Dove					
Cardinal Honeyeater	0.40				
Micronesian Kingfisher	1.10				
Noddy Tern					
P.T. Dove	34.90	39.00	37.89	37.26	35.89
Chinese Painted Quail					
Guam Rail					
Chestnut Mannikin	1.30	0.80		3.29	1.77
Eurasian Tree Sparrow	13.90	22.90	36.75	13.59	17.50
Micronesian Starling	1.30	1.30			
Bridled White Eye					
White Tern	1.80	1.80		1.53	
Black Francolin					9.75

Starling). The native Yellow Bittern declined. The introduced species generally declined (drongo, Philippine Turtle-Dove) or showed no discernable trend (Chestnut Mannikin and Eurasian Tree Sparrow).

The Northwest Field route is the only route that still has native forest birds (Tables 5) or (Table 5 & 6). The Mariana Crow was observed on every count during FY 1988. There

Table 5. Average number of birds per 100 Km observed each month on the Northwest Field roadside counts during Fiscal Year 1988.

Species	Oct.	Nov.	Dec.	Jan.	Mar.	Apr.	May	June	July	Aug.	Sept.	Total	X/Count	X/100 Km
Yellow Bittern	3	1					1	1	3	2		11	0.50	2.72
Mariana Crow	7	2	6	7	1	5	5	1	1	2	7	44	2.45	10.90
Black Drongo	40	31	45	23	18	13	15	27	27	23	28	290	14.41	71.82
Rufous-fronted Fantail														
Mariana Fruit-Dove														
Guam Broadbill														
Golden Plover	89	176	77	39	49	17				14	3	464	21.09	114.91
White-throated Ground Dove														
Cardinal Honeyeater														
Micronesian Kingfisher					1							1	0.05	0.25
Noddy Tern														
P.T. Dove	50	19	16	7	18	10	26	48	18	23	7	242	11.00	59.93
Chinese Painted Quail														
Guam Rail														
Chestnut Mannikin														
Eurasian Tree Sparrow														
Micronesian Starling														
White Tern														
Km	35.6	36.4	54.6	21.0	36.0	18.3	35.4	54.8	19.3	54.7	37.5	403.8		
Miles	22.1	22.6	33.9	13.1	22.4	11.4	22.0	34.1	12.0	34.0	23.3	250.9		
Counts	2	2	3	1	2	1	2	3	1	3	2	22		

Table 6. Average number of birds per 100 Km observed each fiscal year on the Northwest Field roadside counts between 1984 and 1988.

Species	1984	1985	1986	1987	1988
Yellow Bittern	9.90	3.70	11.62	4.69	2.72
Mariana Crow	32.50	28.60	19.44	13.85	10.90
Black Drongo	439.10	369.00	282.64	115.96	71.82
Rufous-fronted Fantail	2.70				
Mariana Fruit-Dove	2.70	0.60			
Guam Broadbill					
Golden Plover	51.60	17.40	88.26	101.66	114.91
White-throated Ground-Dove	1.70	0.60	2.68		
Cardinal Honeyeater	8.90				
Micronesian Kingfisher	9.50	4.60	1.12	0.45	0.25
Noddy Tern					
P.T. Dove	175.23	159.90	123.11	81.11	60.88
Chinese Painted Quail					
Guam Rail	0.30	0.30	0.22		
Chestnut Mannikin	2.00	0.90	1.34		
Eurasian Tree Sparrow	8.20	0.30	5.36	2.46	
Micronesian Starling	20.40	6.00	2.01		
Bridled White Eye					
White Tern	0.70	1.40	0.89		
Black Francolin					

was a single sighting of the Micronesian Kingfisher in March. No other native forest birds were observed during FY 1988. The introduced Black Drongo and Philippine Turtle Dove were observed every month. The five year summary from 1984 to 1988 for Northwest Field (Table 6) indicates a continuing decline for all resident breeding species with the fantail, fruit-dove, ground-dove, honeyeater, rail, mannikin, sparrow, and starling no longer being observed.

Table 7. Results of Northwest Field, North, and North-Central roadside counts showing the mean number of birds per 100 Km of travel, the standard deviation (St. Dev.) and the coefficient of variation (CV).

Species	Northwest Field			North			North-Central		
	X/100 Km	St. Dev.	CV	X/100 Km	St. Dev.	CV	X/100 Km	St. Dev.	CV
Yellow Bittern	2.21	0.70	31.87	1.95	0.81	41.60	3.10	0.84	27.10
Mariana Crow	16.03	5.49	34.27						
Black Drongo	62.47	6.13	9.81	9.85	2.56	26.01	26.14	3.29	12.59
Rufous-fronted Fantail									
Mariana Fruit-Dove									
Guam Broadbill									
Golden Plover	123.56	29.21	23.64	55.67	15.84	28.45	397.40	70.39	17.71
Wh-throated Ground-Dove									
Cardinal Honeyeater									
Micronesian Kingfisher	0.28	0.24	85.27						
Noddy Tern									
P.T. Dove	59.15	6.48	10.95	10.19	2.12	20.77	35.89	11.06	30.82
Chinese Painted Quail									
Guam Rail									
Chestnut Mannikin							1.77	1.47	83.05
Eurasian Tree Sparrow				9.85	2.78	28.26	17.50	2.66	15.20
Micronesian Starling									
White Tern									
Black Francolin							9.75	2.57	26.36

Roadside census work, observations made incidental to Philippine Turtle-Dove counts (DAWR 1988) and Mariana Crow nest snakeproofing (DAWR 1988) suggest that NWF and CWSA on AAFB remain the center of distribution of most of Guam's remaining native forest avifauna.

Work is also being conducted to determine the current distribution and natural history of the Mariana Common Moorhen on Guam. In the past, field work consisted of periodic visits to various wetlands to make and record casual observations of the moorhen. Little work had been done to determine their distribution on the island. And no island-wide wetland survey had ever been conducted. Presently, with the moorhen listed both locally and federally as an endangered species, there exists a great need to study and record its natural history as well as determine its distribution on the island of Guam. To gather information on its natural history, specific wetlands that are known to be utilized by moorhen were surveyed on a regular basis. These surveys were conducted to record their general behavior, courtship, nest types and materials, egg size, clutch size, number of broods per breeding pair, family group interactions and developmental characteristics. The results of this survey will be reported in FY 89.

The monthly moorhen survey at Fena Lake first begun in 1987 (Table 8 and Figure 2), indicates the greatest usage of the lake occurs during the dry season. This suggests that Fena lake harbors most of Guam's moorhen population when more ephemeral lakes dry up during the dry season. The data also indicate that for Fena lake, most successful breeding takes place when the lake level is not fluctuating. Fena continues to be the most important wetland area for the moorhens on Guam.

Table 8. Number of Mariana Common Moorhen observed on monthly Fena Reservoir counts from 4/87 to 10/88.

Date	Adults	Subadults	Chicks	Unknown	Total	Nests	Water Level*
4/87	19	1	2	0	22	0	102'
5/87	46	2	10	2	60	0	98'
6/87	40	16	2	1	59	1	93'
8/87	29	8	3	4	44	2	91'
9/87	6	12	0	4	22	1	96'
10/87	28	1	1	2	32	0	100'
12/87	10	2	0	4	16	1	110'
2/88	29	1	0	3	33	1	111'
3/88	32	0	0	0	32	0	108'
4/88	57	7	0	0	64	0	102'
5/88	52	8	5	1	66	8	98'
6/88	42	14	2	3	61	11	97'
7/88	10	13	1	1	25	0	103'
8/88	7	4	0	6	17	0	111'
10/88	6	0	0	4	10	0	112'

* 112' is dam level.

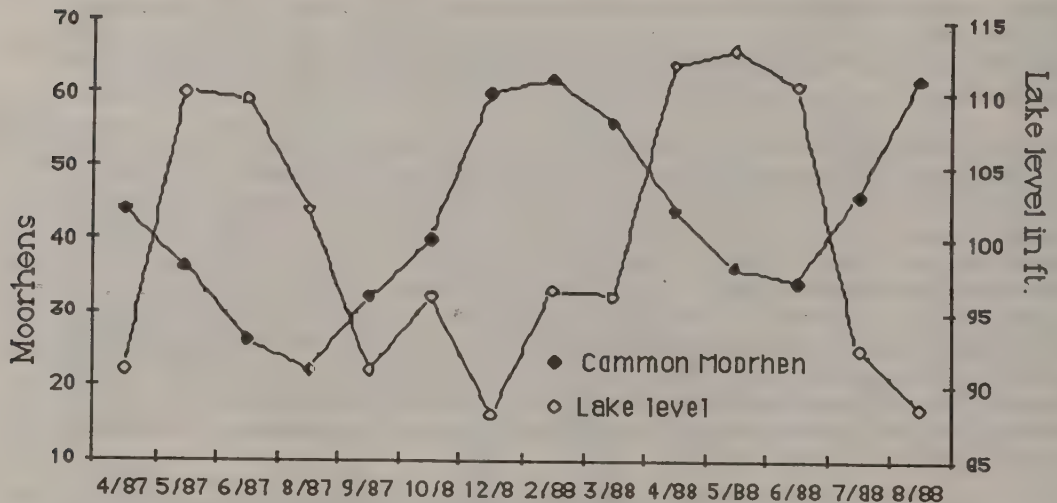


Figure 2. The number of Mariana Common Moorhens of all age classes observed on Fena Lake and its relationship to lake level from 4/87 to 8/88. Note that 112' is the dam level.

The numbers of Island Swiftlets counted during monthly censuses at the Firebreak 4 Cave increased slightly from about 450 birds to 475 birds from July 1987 to May 1988 (Table 9, Figure 3) (DAWR 1987). Several uncharacteristically high or low counts occurred during this period and were probably caused by observer error rather than by actual fluctuations in the cave's population. An alarming and severe decline in the size of the colony began in June 1988 with the population falling to about 210 birds in July 1988 (Table 9, Figure 3). In contrast to the census made on 2 March 1988, when swiftlet activity was high but a low count was obtained, the number of birds recorded in counts during the decline was

noticeably lower to observers, reflecting that a true population decrease had taken place. At the end of FY 1988, the population of swiftlets at the Firebreak 4 Cave was estimated at about 250 birds.

The cause(s) of the decline was not determined. No dead birds were found in the cave. Egg laying and care of young continued during the decline, indicating that some birds in the population remained healthy enough to continue these activities. Immigration of swiftlets to an unknown cave on Naval Magazine or in the Talofoto Valley is also a possibility. Several searches at dusk from lookout points on the eastern side of Naval Magazine did reveal one concentration of birds flying around the side of a limestone hill about 0.8 km west of the colony cave, but a thorough search of the hill several days later found no caves to be present. Subsequent observations revealed no further concentrations of birds at this location.

Evidence of snake predation on Island Swiftlets was discovered at the colony in May and June with the finding of several snake droppings containing swiftlet feathers below a section of active nests. A large number of snake tracks were found in the cave's guano during both months. A trapping program for snakes was started in the cave in late June and continued until mid-August. No snakes were captured in 248 trap-nights with glue boards (sticky traps) and 115 trap-nights with mouse-baited funnel traps. Although snakes were never caught, they did approach both types of traps closely on several instances, as determined by tracks. Although some predation on swiftlets did occur at the cave, it seems unlikely that snakes were responsible for the large decline that occurred during June and July. One piece of evidence to support this is that swiftlets continued to nest and roost throughout the actively used portion of the cave roof during this period. No entire sections of nests were found abandoned, which would have suggested that snakes may have discovered a way of reaching a group of nests and preying upon the birds using them.

Reproductive indicators of swiftlets were examined from February 1987 to September 1988. Although evidence of breeding was present year-round, a peak in activity occurred during a 7-month period from February to August when most egg laying apparently took place (Table 9) (DAWR 1987). January, September, and October appear to be transition months when moderate levels of breeding activity were noted. Reproduction was lowest in November and December. These results agree fairly closely with those of similar studies currently being conducted on Saipan (J. Reichel, pers. comm.).

The abandoned swiftlet cave at Firebreak 3 on Naval Magazine, which is located about 1 km northwest of the cave at Firebreak 4, was visited six times during the year to look for evidence of recolonization by swiftlets. All visits but one were made during the day between 1000 and 1400 hours. Five birds were seen flying over the cave entrance and surrounding forest on 15 July. During a count made at dusk on 3 August 1988, no birds entered the cave to roost for the night.

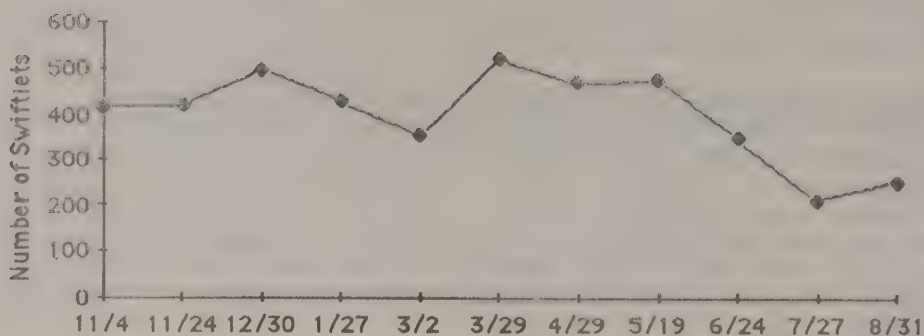


Figure 3. The number of Island Swiftlets observed at Naval Magazine Cave during monthly surveys from November 4, 1987 to August 31, 1988.

Table 9. Results of censuses for Island Swiftlets at the Firebreak 4 Cave on Naval Magazine during FY1988. Evidence of reproductive activities of swiftlets is also presented.

Date	Net No. of Birds Entering Cave	No. of Birds Estimated in Cave at Start of Count	Total No. of Birds Counted	Reproductive Parameters				
				No. of Whole Eggs Found	No. of Eggshell Fragments Found	No. of Nestlings Heard	No. of Nestlings Seen	Incubation or Brooding Observed
4 Nov 1987	366	50	416	0	13	several	none	undetermined
24 Nov 1987	386	34	420	0	1	several	1	undetermined
30 Dec 1987	471	25	496	1	1	several	undetermined	undetermined
27 Jan 1988	377	50	427	1	14	several	many	yes
2 Mar 1988	309	45	354	3	29	several	many	yes
29 Mar 1988	455	65	520	7	29	several	many	yes
29 Apr 1988	413	56	469	3	32	several	many	yes
19 May 1988	424	51	475	7	32	many	many	yes
24 June 1988	277	68	345	6	16	several	1	undetermined
27 July 1988	141	71	212	present ^a	present ^a	several	none	undetermined
31 Aug 1988	208	45	253	present ^a	present ^a	several	several	undetermined
30 Sept 1988			no count	1	6	several	none	undetermined

^a present but numbers were not counted because of disturbances to the cave floor during snake trapping

Small numbers of swiftlets continue to be observed in the upper Geus River valley north of Merizo, indicating that a small population of birds may still inhabit this area. Although biologists have made infrequent observations in this area, they did see 2-3 birds feeding on the upper south slopes of Mt. Sasalaguan on 4 May 1988, and at least 3-4 birds foraging near the top of Mt. Finansanta on June 1984.

RECOMMENDATIONS

1. Continue bi-monthly roadside counts over the three routes in northern Guam.
2. Continue census of the Guam Rail in areas where appropriate.
3. Continue to census the Mariana Crow in order to estimate population size and distribution on Guam.
4. Continue breeding biology studies and attempts to snake proof nest sites of the Mariana Crow on Guam.
5. Continue monthly censuses and efforts to assess the reproductive activity of Island Swiftlets.
6. Evaluate causes of swiftlet decline at Naval Magazine Firebreak 4 Cave and implement efforts to ameliorate the decline.
7. Continue monthly Mariana Common Moorhen counts on Fena Lake.
8. Complete survey and inventory of wetlands on Guam.
9. Develop and implement methods for control of the brown tree snake.
10. Continue efforts to captive breed endemic endangered native land birds on Guam and at stateside zoos.
11. Implement plans to translocate captive bred Guam Rails to Rota, C.N.M.I. for purposes of establishing a wild population in a snake-free environment.

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Report prepared by: Robert E. Beck, Jr., Gary J. Wiles and Michael W. Ritter.

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: E-1-3

STUDY NO.: 5

JOB NO.: 2

JOB TITLE: Habitat Protection and Management for the Native Birds of Guam.

PERIOD COVERED: October 1, 1987 to September 30, 1988

SUMMARY

A total of 9 Mariana Crow, *Corvus kubari*, nests were located. Attempts were made to "snakeproof" only one nest. None of these nests successfully hatched eggs. Two unconfirmed sightings of fledgling crows were reported during the year. Conventional Weapons Storage Area (CWA) and Northwest Field, Anderson Air Force Base remains the center of distribution for crows on Guam.

BACKGROUND

Since the creation in 1960 of the Guam Division of Aquatic and Wildlife Resources (DAWR), census data from roadside counts, station counts, and transect counts have documented the reduction in range and numbers of the Guam Rail, *Rallus owstoni*, and other native birds (DAWR 1961-1987; Jenkins 1979, 1983; Engbring and Ramsey 1984). Most native forest birds are now either extirpated from the wild or restricted primarily to Northwest Field and Conventional Weapons Storage Area (CWA) and surrounding cliffline areas on Andersen Air Force Base (AAFB) in Northern Guam.

Predation by the brown tree snake, *Boiga irregularis*, is believed to be the major factor contributing to recent declines in native bird populations (Savidge 1986, 1987; Conry 1988).

A captive breeding program for the Guam Rail and Guam subspecies of the Micronesian Kingfisher, *Halcyon c. cinnamomina* was successfully begun in 1983 on Guam and at mainland U.S. zoos in cooperation with the American Association of Zoological Parks and Aquariums (DAWR 1984-1986; Derrickson 1986; Shelton 1986).

During the spring and summer of 1985 the DAWR began to experiment with the snake-proofing of both Guam Micronesian Kingfisher and Mariana Crow active nests. Sam Marshall, New York Zoological Society, spent the summer of 1985 on Guam studying the breeding biology of the kingfisher (Marshall in prep). As a part of his study and in cooperation with the DAWR, a single kingfisher nest site was snake-proofed using a 4' galvanized sheet metal sleeve on the trunk of the nest tree. In addition, nearby vegetation was trimmed back to prevent intertree movement of the brown tree snake. A single kingfisher was successfully fledged and collected from the site and it is now part of the captive breeding program (DAWR 1985).

Gary Michael, Philadelphia Zoological Society, visited Guam during the fall of 1985 and studied the breeding biology of the Mariana Crow for 3 months (Michael 1986). During that period, DAWR and Michael attempted to snake-proof several crow nest trees. The method used was similar to that mentioned above for the kingfisher and involved encircling the trunk of the nest tree with a 4' long sleeve of galvanized sheet metal 4' to 6' above the ground. In addition, all surrounding vegetation was trimmed so that the brown tree snake could not move through the canopy into the nest tree. No crow nesting attempts observed during this period were successful (DAWR 1985).

During FY 1987, DAWR attempted to snake-proof six Mariana Crow nest trees containing actively incubating pairs. All nests failed to hatch young. The cause of the failure could not be positively determined but snake predation was suspected.

OBJECTIVES

To develop methods for protecting roosting and nest sites for endangered native forest birds and fruit bats from predation by the brown tree snake.

PROCEDURES

1. Locate active Mariana Crow nest sites on Guam.
2. Develop methods for "snake-proofing" Mariana Crow nest sites.
3. Implement methods for snake-proofing nest sites of Mariana Crow.
4. Consult with herpetologists working on the control of the brown tree snake to develop appropriate methods for snake-proofing crow nest sites.

RESULTS

During the fiscal year, this project was active on a part time basis only as staff became available. Nine nests were observed with five located on CWA and four on Northwest Field, AAFB. All were in emergent *Elaeocarpus* trees except for one in a *Tristiopsis*. No systematic census of crows on Northern Guam was conducted and the numbers compiled above do not necessarily represent relative abundance of crows nesting in each area.

Attempts were made to snake proof one nest site. It was located in an emergent *Elaeocarpus* tree. The snake proofing method used was similar to that used in FY 1987 (DAWR 1987). The surrounding vegetation was trimmed back so snakes could only approach the nest via the main trunk. The main trunk was coated with tanglefoot, a sticky and very thick commercial liquid that has the consistency of heavy oil. The application was applied in a 3' band around the trunk of the tree to inhibit snake movement in the trunk. The tree was visually searched for the presence of snakes from the ground after snake-proofing.

The nest failed to hatch eggs. It was not possible to observe the contents of the nest after it was abandoned except by using a spotting scope from a distance but the nest appeared undamaged. It was not possible to establish the cause of the unsuccessful nesting but snake predation is suspected. This same pair is presently in the process of building another nest in the same tree as September, 1988.

In addition the other eight nests observed this year that were not "snakeproofed" also failed to produce young.

During FY 1988, two possible sightings of fledgling crows were made, although none could be confirmed. One was at Pati Point and the other was on Northwest Field. The last confirmed sighting of a fledgling crow was observed in 1985 (DAWR 1985).

Field observation made while searching for crow nests indicates that the CWA and Northwest Field, both on Anderson Air Force Base are the center of distribution for crows on Guam.

With the hiring of a herpetologist at the Division it is expected that this project will become much more active during FY 1989.

RECOMMENDATIONS

- 1 Continue efforts to locate active Mariana Crow nest sites.
2. Continue to snake-proof active nest sites where possible.
3. Develop and test new methods for snake proofing nest trees.
4. Consult with herpetologists working on the control of the brown tree snake to develop appropriate methods for snake-proofing crow nest sites.

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Report prepared by: Robert E. Beck, Jr.

**JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT**

STATE: Territory of Guam

PROJECT NO.: E-1-3

STUDY NO.: 6

JOB NO.: 1

JOB TITLE: Law Enforcement and Legal Protection for the Marianas Fruit Bat.

PERIOD COVERED: October 1, 1987 to September 30, 1988

SUMMARY

This job was relatively inactive during this segment. Activity consisted mainly of monitoring fruit bat imports, documenting fruit bat seizures, and investigating colony disturbances for signs of illegal hunting activity. Results of this activity was consolidated with other fruit bat research and is reported under Job E-1-2, Natural History, Ecology, and Habitat Protection for the Marianas Fruit Bat, which ran concurrently.

Report prepared by: Gary J. Wiles

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: E-1-3

STUDY NO.: 6

JOB NO.: 2

JOB TITLE: Natural History, Biology, and Habitat Protection for the Marianas Fruit Bats.

PERIOD COVERED: October 1, 1987 to September 30, 1988

SUMMARY

Guam's fruit bat population is currently estimated at 500 to 600 animals, which is approximately equal to that recorded in FY 1987. Several hundred bats apparently flew to Guam from Rota after Typhoon Roy in January but a similar number of bats probably returned to Rota in about May. Bat colonies used eight roosts on Pati and Late Points during the year. A low incidence of young bats was again noted on Guam in FY 1988, and one instance of snake predation on a young bat was reported. One known case of illegal hunting of fruit bats occurred during the year, and there was also one case of human disturbance of a colony that may not have involved poaching. In FY 1988, 13,587 frozen fruit bats were imported to Guam from other islands for human consumption, an increase of 44.5% from the previous year.

BACKGROUND

The Marianas fruit bat (*Pteropus mariannus mariannus*) is endemic to the Mariana Islands and has been under investigation by the Guam Division of Aquatic and Wildlife Resources (DAWR) since 1962 (DAWR 1964-1987). These bats, considered a delicacy by Chamorro residents, steadily declined in number during the 1960s (Perez 1972). Thereafter, annual surveys revealed that only a few dispersed, solitary bats remained in suitable habitat on Guam which once supported colonies containing hundreds of bats (Wheeler and Aguon 1978, Wheeler 1979). Reasons for the decline included: increased human population pressures that resulted in overhunting and permanent habitat destruction, commercial exploitation of bats as a food, periodic severe typhoons, the lack of an adequate enforcement staff, and delays by the local legislature in passing protective legislation (Wheeler 1979). The Marianas fruit bat and the little Marianas fruit bat (*P. tokudae*) finally received full protection from hunting in 1973. Both species were placed on Guam's territorial Endangered Species List in 1981 and on the U.S. Endangered Species List in August 1984, but *P. tokudae* is now thought to be extinct. The island's population of Marianas fruit bats grew substantially to an estimated 850 - 1,000 animals between 1980 and 1982, probably from immigration of bats from Rota (Wiles 1987a). However, numbers have declined since 1983 because of continued illegal hunting and suspected predation on bats by brown tree snakes (*Boiga irregularis*) (Wiles 1987a, 1987b). Guam's fruit bat population was estimated at 500-600 animals in FY 1987 (DAWR 1987).

OBJECTIVES

To continue status surveys and natural history studies and to provide for continued protection of habitat as called for in the Fruit Bat Recovery Plan.

PROCEDURES

1. Survey fruit bat distribution and numbers in Guam and the Commonwealth of the Northern Mariana Islands (CNMI) as initiated in the late 1970s.
 - a. Conduct annual surveys of fruit bats along Guam's northern cliffline with periodic surveys made elsewhere on the island. The emphasis of surveys should be to search for solitary bats and additional bat colonies.
 - b. Conduct monthly censuses at known bat colonies on Guam.
 - c. Assist the CNMI Division of Fish and Wildlife (CNMIDFW) with surveys of fruit bats on other islands as needed.
2. Record information on the behavior and reproduction of fruit bats in colonies.
3. Determine habitat use of fruit bats. Visit abandoned roost colonies and record information about terrain and the size and abundance of vegetation present.
4. Monitor fruit bat imports to Guam from other islands in Micronesia and the Pacific.
5. Investigate illegal hunting of fruit bats on Guam.
 - a. Visit abandoned roosting sites of colonies to determine illegal hunting effort.
 - b. Assist Conservation Officers with investigations of bat poaching.

RESULTS

Locations of Bat Colonies on Guam

Fruit bats roosted at eight known sites on Pati and Late Points during FY 1988 (Figure 1). Roost 1 was occupied for almost 8 months from late October to May but other roosts were used for shorter periods of several days to three months (Table 1). Roost 1 has been inhabited extensively in previous years (DAWR 1987). Two new locations were used as roosts in FY 1988. Roost 20 was located about 100-150 m north of Roost 19 on the east side of Pati Point. Roost 21 occurred on Late Point and represents the most southern roosting site along the eastern cliffline on Andersen Air Force Base (AAFB) since 1981. A small colony of about 30 bats was reported to have roosted at Fadian Point for several weeks in March. A conservation officer reported that he observed another colony with about 30 bats roosting south of the Conventional Weapons Area of AAFB (or about 1,200 m northeast of Agafo Gumas village) on 1 June.

Efforts were made to determine the causes for the frequent changes in bat roosting sites that occurred in FY 1988. Eleven major roost changes involving large numbers of bats took place during the year, which is the most noted for any year since observations began in 1981. Roost 16 was disturbed by people twice, with poachers going there once on about

18 October and hikers or poachers intruding there a second time on about 12 August (see Illegal Hunting for further details). Many smaller roosts were occupied temporarily (Table 2) and were apparently deserted when bats joined larger roosts. No evidence of human visitation was found at Roost 18 when it was visited 3 weeks after being abandoned in late January. Bats at Roosts 15 and 17 moved to Roost 1 during a period of gusty winds in late October. Roost 1 appeared to offer better protection from winds, and in fact, this site continued to be used during Typhoon Roy, which struck northern Guam with sustained winds of about 75 mph on 12 January.

Survey of Fruit Bats on Guam

Censuses of fruit bats at colonies varied greatly during the year, ranging from 182 to 709 animals (Table 2). Counts were highest from late January to April and were almost certainly caused by an influx of 300 to 350 bats from Rota (see Survey of Fruit bats on Rota for further details). In a two-day period from 26 to 28 January, numbers of bats at Roosts 1 and 15 rose dramatically from 302 to 709 bats (Table 2). During February, the number of bats on Pati Point declined slightly and coincided with reported sightings of a small colony at Fadian Point. The number of bats on Pati Point returned to about 300 to 400 sometime between 28 April and 20 May, indicating a probable return of bats to Rota. During the remainder of the year, censuses fluctuated greatly from month to month as bats moved frequently between different roosts, some of which were difficult to view and to conduct accurate counts. Also, it seems likely that bats may have used one or more other roosts that were never found despite several searches for them from the ground. An aerial survey of Guam's entire northern cliffline on 29 August also failed to locate any previously unknown colonies.

An estimate of the island's population of fruit bats at the end of FY 1988 was determined using the September count of 344 bats at Roosts 1 and 15. Because some individuals were probably hidden by thick foliage during that count, the total number of adults in the two colonies was likely to be 10 to 20% higher than the actual number recorded. In addition, approximately 65% of the adults in the colonies were harem females (DAWR 1985), with approximately 20% of these animals possessing unweaned young (see Natural History). These figures provide an estimate of 378 to 413 adults and 76 to 83 juveniles; or a total of 454 to 496 bats, on Pati Point during September.

Daytime sightings of single fruit bats were made during the year in the Conventional Weapons Storage Area on AAFB (3 sightings), in Northwest Field (2 sightings), along the cliffines at Ritidian Point (6 sightings) and Fadian Point (2 sightings), in Asan (2 sightings), and over the southern half of Fena Lake at Naval Magazine (5 sightings). Solitary bats were seen on four of nine surveys for common moorhens made during the year at Fena Lake. Nighttime sightings of bats occurred at Northwest Field (4 sightings), in the Tarague basin at AAFB (3 sightings), at Asdonlucas near Pagat, Yigo (1 sighting), and near Alatgue Spring about 1.5 km northeast of Umatac Village (1 sighting). A nighttime survey of fruit bats was conducted in the Northwest Field-Ritidian Point area on 26-27 September. Two bats were seen during 16 man-hours of searching, indicating that bats forage uncommonly in this area. During a similar census made in Northwest Field only in September 1987, one bat was recorded during 12 man-hours of surveying.

Excluding bats residing in the colonies at Pati Point, an estimated 25 to 50 fruit bats are believed to live solitarily or in small groups along the island's northern cliffline that extends from Bijia Point to Iates Point. An additional 25 to 50 animals probably inhabit Naval Magazine, Talofofo, and Malojloj. Based on these figures, Guam's island-wide population of fruit bats at the end of FY 1988 was estimated to contain 504 to 596 animals. This number is identical to the FY 1987 estimate of 500 to 600 animals (DAWR 1987).

Survey of Fruit Bats on Rota

The DAWR assisted the CNMIDFW in FY 1988 with a survey of fruit bats on Rota from 26-30 October. Three bat colonies were found during the survey, however, accurate counts of roosting bats could be made only at the colony at Uyulan Hulo. The count was performed with a 15-60X spotting scope and the results were increased by 10-20% to account for bats hidden in foliage. A total of 999 bats were counted there with an estimate of 1,100-1,200 animals made. At Palii, 80 bats were counted prior to a colony disturbance which occurred before the census was completed. An estimate of 150 bats was made for this site. An attempt to find a vantage point for counting a third colony at As Puepuenge failed, thus an evening departure count was used to census this roost. About 420 bats were counted during the departure count with an estimate of 800 bats made for the entire roost. Occasional solitary bats were noted during station counts around the island and probably totaled several hundred animals. Based on these counts, a total population of approximately 2,250-2,350 bats was estimated for Rota in October 1987.

On 12 January, Rota was devastated by a severe storm, Typhoon Roy, which caused considerable damage to the island's forests. Heavy poaching of bats occurred for one to two months after the storm. This mortality combined with emigration of about 300 to 350 bats to Guam reduced Rota's population to about 1,500 bats by about March (P.O. Glass, pers. comm.).

Data on the incidence of harem females with young (see Natural History) were gathered during this survey and on a second trip made from 22-28 February, when a lizard survey of Rota was conducted. Reproductive data gathered during these trips will be used by the CNMIDFW to write a detailed final report on the abundance and ecology of Rota's fruit bats.

Natural History

Reproduction - During FY 1988, 50 to 103 harem females were identified monthly at roosts on Pati Point and examined visually through a spotting scope for the presence of unweaned young. Females with young comprised 7.0 to 19.8% of the females identified monthly (Table 3). As in the three previous years (DAWR 1985-1987), most (95%) of the juveniles observed were judged to be small-sized; no large young was observed during the year.

Observations of female fruit bats were also made on Rota in October and February. About one-third of the females seen in October possessed young (Table 3). The relative proportions of the size classes of juveniles were: small, 28%; medium, 37%; and large, 35%. The percent of females with young was lower than in April 1987, when 53.8% of adult females were accompanied by young, however, this amount was still much higher than for any month during the past several years on Guam (DAWR 1985-1987). Observations in February occurred 6 weeks after Typhoon Roy and none of 68 females recorded possessed young. It is believed that storm-related mortality of juveniles or physiological stresses on adult females were responsible for the sudden disappearance of young from the population.

Predation - Gordon Rodda, a visiting biologist with the U.S. Fish and Wildlife Service, interviewed a Mr. Herbert Cruz, who reportedly killed a snake with a young fruit bat that was 10-12 cm long in its stomach in about July or August. The snake was found near the lower entrance of the Artero family property on the road leading to Naval Facility on

Ritidian Point. A similar report was obtained from a hunter in 1982 (DAWR 1983). Both reports support the theory that snakes prey on juvenile fruit bats on Guam.

Illegal Hunting

Poaching has long been a major cause of mortality of *P. mariannus* on Guam and other islands in the southern Marianas (Wiles 1987a, 1987b; Wiles et al., in press). One case of illegal hunting was recorded on Guam in FY 1988. This occurred at Roost 16 on about 18 October. An inspection of the site was made five days after the bats abandoned the roost. A single piece of plastic shotgun wadding and a badly decomposed bat carcass were recovered from the site but no other signs of hunting, such as empty shotgun shells or cut vegetation, were discovered. It is difficult to estimate the number of animals killed during this incident. Conservation officers also received a report of a hunter who killed five bats at an unknown site in about June or July.

One other noteworthy incident occurred during the year and illustrates that human disturbance is a threat to bat colonies, even when no hunting is involved. On about 12 August, several people walked into Roost 16, causing it to be abandoned. An investigation was made two weeks later and found a trail leading northeastward through forest from the vicinity of the borrow pits between Lafac and Late Points to the roost. The trail was marked by numerous cut tree branches, blaze marks on tree trunks, and discarded soft drink bottles. No signs of bat poaching were found at the roost, nor was there any evidence of coconut crab hunting along the trail. Thus, it is possible that the people, who may have been Air Force personnel or dependents, had gone into the site simply to look at the bat colony and inadvertently disturbed it by approaching too closely.

Fruit Bat Imports

During FY 1988, 51,636 fruit bats were requested for import (Table 4), an increase of 13.7% from the previous year (DAWR 1987). The number of import permits issued by the DAWR increased to 633 during FY 1988, a rise of 24.6% over FY 1987.

An estimated total of 13,587 frozen fruit bats in 317 shipments were actually shipped to Guam from other islands in FY 1988 (Table 5). These figures represent a 44.5% increase in the estimated number of bats imported to Guam and a 47.4% increase in the number of shipments received when compared to FY 1987 (DAWR 1987). Palau was the major source of fruit bats for the Guam market in FY 1988, exporting 10,585 animals during the year (Table 5). This amount represented 77.9% of the total number of bats imported to Guam. Truk (1,216 bats) and Pohnpei (1,088 bats) were the second and third largest exporters of fruit bats, respectively, and together represented 17.0% of the import total for FY 1988. This continues last year's trend in which nearly all of the bats brought to Guam originated from the Caroline Islands (DAWR 1987).

Western Samoa and the Philippines continued to be minor suppliers of fruit bats in FY 1988, with a total of just three shipments containing 560 animals entering from these countries (Table 5). In November, Continental Airlines initiated a twice weekly flight to Port Moresby, Papua New Guinea, but this did not result in any shipments of fruit bats arriving from there during the rest of the year. Garuda Airlines ended its weekly flight between Guam, Sulawesi, and Bali on 6 April. Almost no bats entered Guam from Indonesia during this flight's two years of existence (DAWR 1986-1987).

During FY 1988, 503 fruit bats in 47 shipments were confiscated by the Guam Customs and Quarantine Division upon entry into Guam. These figures represented 3.7% of the total bats brought to the island and 14.8% of the shipments received during the year.

Shipments were seized for a variety of violations including lack of import permits, lack of certificates of origin, or because the bats originated from islands where they were protected by local laws.

A number of fruit bats collected from confiscated shipments over the past several years were identified by Dr. Karl Koopman of the American Museum of Natural History in October 1988. His identifications are documented here. Three shipments from Saipan totaling 8 bats contained *P. mariannus*, all of which appeared to have originated within the Marianas. These shipments were brought to Guam on 16 September 1985, 23 June 1986, and 13 August 1988. This may indicate that considerable illegal hunting of bats is occurring in the islands north of Saipan and that the bats are brought to Saipan for sale or distribution. Three bats brought from Rota in two small shipments on 19 April 1987 and 16 November 1987 were each identified as *P. mariannus*. Shipments of fruit bats entering Guam from the Philippines have contained a variety of species. Two *P. speciosus* were confiscated on 11 April 1986, and single *Acerodon jubatus* and *P. vampyrus* were confiscated in separate shipments of one bat each on unknown dates. Another shipment, which was abandoned by the owner on 3 June 1987 upon entry to the Guam airport, contained 89 *Rousettus amplexicaudatus* and 64 *Scotophilus kuhli*. A shipment from Saipan, whose bats had been purchased in a store on that island, contained 11 *P. vampyrus* and arrived on Guam on 5 June 1986. All of the *P. vampyrus* specimens examined by Koopman were identifiable to the subspecies *P. v. lanensis*, which is endemic to the Philippines.

RECOMMENDATIONS

1. Survey bat numbers and distribution along Guam's entire northern cliffline once or twice annually. Searches for additional colonies may prove to be productive because continued poaching at bat roosts on Rota (P.O. Glass, pers. comm.) could cause large numbers of bats to move to Guam.
2. Continue to make observations at Guam's bat colonies. Information should be gathered on reproductive biology, behavior within the colonies, and the sex and number of bats present.
3. Known bat roosting and foraging areas should be patrolled regularly by Conservation Officers. Part of their effort should be aimed at maintaining a visible presence at Jinapsan and Pajon Points, where poaching has been a serious problem in previous years.
4. Determine the amount of predation on fruit bats by brown tree snakes. The age classes of bats that are most susceptible to predation by snakes must be investigated. The extent of predation occurring at colonies and during foraging at night should be determined.
5. Form a cooperative bat research program with the CNMI to collect information on the locations and sizes of colonies, reproductive biology and behavior within colonies. Most of the work done under this program would be conducted on Rota where a moderately sized bat population is found but where logistics prevent the CNMI from doing extensive fieldwork. Emphasis of this project would be to identify colonies should they move between Guam and Rota.
6. Continue to monitor fruit bat imports entering Guam. Export permits or certificates of origin should continue to be required for all shipments to ensure that the bats have been legally harvested, that the place of origin is known, and

that the government authorities at the place of origin are aware of the drain on their fruit bat populations.

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Report prepared by: Gary J. Wiles

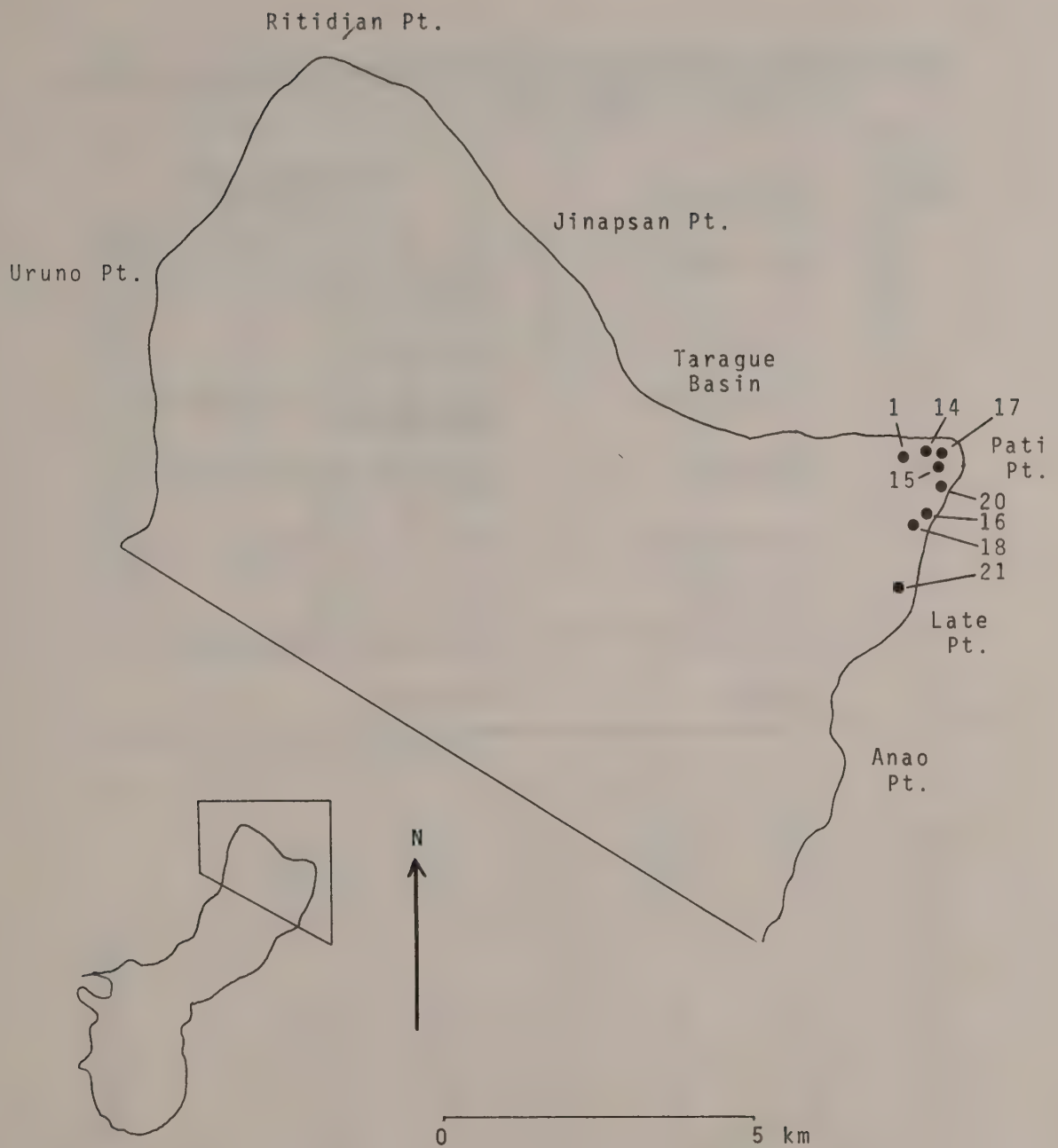


Figure 1. Locations of 8 roosts used by Marianas fruit bats in northern Guam, FY 1988. Numbers correspond to roost numbers listed in Table 1. Roosts are designated by closed circles (●).

Table 1. Approximate dates of use of eight roost sites used by colonies of Marianas fruit bats on Guam in FY 1988.

Roost number	Roost Location	Approximate periods of use by bats
1	North Pati Point	28 Oct 87-18 May 88, 12-17 Aug 88, 24 Sept 88-present
14	North Pati Point	18-23 May 88
15	North Pati Point	18 Oct-5 Dec 87, 27 Aug-7 Sept 88, 18 Sept 88-present
16	East Pati Point	15 Jul-18 Oct 87, 5 Nov-5 Dec 87, 23 May -12 Aug 88
17	North Pati Point	18-28 Oct 87, 18-23 May 88
18	East Pati Point	5 Nov 87-27 Jan 88
20	East Pati Point	23 May-16 Jul 88, 18-24 Sept 88
21	Late Point	17-27 Aug 88

Table 2. Counts of Marianas fruit bats at roosts on Andersen Air Force Base, Guam in FY 1988.

Date	Roost Number								Total
	17	15	16	18	1	14	20	21	
22 Oct 1987	159	227	0	0	0	0	0	0	386
20 Nov	0	57	45	5	366	0	0	0	475
23 Dec	0	0	0	90	310	0	0	0	400
26 Jan 1988	0	0	0	70	232	0	0	0	302
28 Jan	0	0	0	0	709	0	0	0	709
19 Feb	0	0	0	0	635	0	0	0	635
31 Mar	0	0	0	0	692	0	0	0	692
28 Apr	0	0	0	0	699	0	0	0	699
20 May	+	0	0	0	0	+	0	0	-
29 Jun	0	0	70	0	0	0	+	0	-
6 Jul	0	0	345	0	0	26	0	0	371
26 Jul	0	0	332	0	0	0	0	0	332
12 Aug	+	0	0	0	0	0	0	0	-
25 Aug	0	0	0	0	0	0	0	182	182
29 Aug	0	260	0	0	0	0	0	0	260
16 Sept	?	0	0	0	0	0	0	0	-
19 Sept	0	+	0	0	0	0	30	0	-
29 Sept	0	66	0	0	278	0	0	0	344

+ = Bats present at roost but no count made; - = no total count made; ? = colony was not visited.

Table 3. Number of harem females observed with unweaned young at colonies on Guam and Rota from October 1987 to September 1988.

	No. of females observed	No. of females without young	No. of females w/ small young	No. of females w/ medium young	No. of females w/ large young	% of females with young
<u>Guam</u>						
Oct						No Data
Nov	76	69	6	0	0	7.9
Dec	85	77	7	1	0	9.4
Jan	64	57	7	0	0	10.9
Feb	95	81	14	0	0	14.7
Mar	98	90	6	2	0	8.2
Apr	103	94	9	2	0	10.7
May	63	56	7	0	0	11.1
Jun	57	53	4	0	0	7.0
Jul	69	58	11	0	0	15.9
Aug	50	45	5	0	0	10.0
Sept	86	69	17	0	0	19.8
Total		749	93	5	0	11.4*
<u>Rota</u>						
Oct	169	112	16	21	20	33.7
Feb	68	68	0	0	0	0.0

* = Year-round average is the sum of the percent of females with young for all months divided by 11.

Table 4. Numbers of frozen fruit bats requested for import to Guam between October 1, 1987 to September 30, 1988.

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total	No. of Permits Issued
Palau	1,240	1,460	3,450	2,732	1,294	5,100	3,480	3,022	3,416	2,651	2,868	1,310	32,023	432
Truk	890	675	350	515	460	1,270	1,235	1,270	1,430	475	1,100	200	9,870	105
Pohnpei	595	500	400	295	385	575	370	330	460	150	668	965	5,693	79
Philippines				500		100	300	400	500		400	400	2,600	8
Western Samoa		100					100					1,000	1,200	4
Indonesia	100												100	1
Kosrae										50		20	70	2
Rota								50					50	1
Papua New Guinea									30				30	1
TOTAL	2,825	2,735	4,200	4,042	2,139	7,045	5,485	5,072	5,836	3,326	5,036	3,895	51,636	633

Table 5. Numbers of frozen fruit bats imported to Guam from October 1, 1987 to September 30, 1988.

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total*	No. of Shipments Received*	No. of Bats Confiscated	No. of Shipments Confiscated
Palau	579	513	695	178	1,029	1,178	1,297	945	846	1,941	937	447	10,585	239	285	29
Truk	68	148	114	143	200	54	30	162	163	99	15	20	1,216	38	89	4
Pohnpei	136	86	30	20		50	70	45	78	100	203	270	1,088	27	41	4
Western Samoa		100														
Philippines										150			460	2	0	0
Unknown	50		4				12						150	1	0	0
Yap			12		3								66	5	66	5
Saipan												6	15	3	15	3
Rota		1											6	1	6	1
TOTAL	833	848	855	341	1,232	1,282	1,409	1,152	1,087	2,290	1,155	1,103	13,587	317	503	47

*Totals include confiscated bats.

JOB PROGRESS REPORT RESEARCH PROJECT SEGMENT

STATE: Territory of Guam

PROJECT NO.: E-1-3

STUDY NO.: 7

JOB NO.: 1

JOB TITLE: Biology of the Brown Tree Snake

PERIOD COVERED: October 1, 1987 to September 30, 1988.

SUMMARY

Studies on the impact of the brown tree snake, *Boiga irregularis*, on Guam's avifauna and on the ecology and biology of this snake are in progress.

BACKGROUND

The loss of a DAWR staff member (Julie Savidge) resulted in the recruitment of a staff herpetologist (Michael McCoid) to continue natural history and control studies of *Boiga irregularis*.

OBJECTIVE

To determine the impact of predation by *B. irregularis* on bird populations and to study the natural history and biology of this snake.

PROCEDURES

1. Analyze existing raw data left by Julie Savidge.
2. Use recent data collected by M. McCoid to augment the data base (total number of snakes used in this analysis is 851 although not all were used for each subsection in the Results).

RESULTS

Population Structure

The smallest known *B. irregularis* is 350 mm snout-vent (SV) length and the largest is 2400 mm SV. Plotting SV length versus numbers yields a distribution curve that is skewed. The majority of snakes (641) are less than 1150 mm SV while 158 snakes were greater than 1150 mm SV. The change in size distribution occurs around 1150 mm SV. There is a drop in numbers of snakes at this point from what we would ordinarily expect in a normally distributed population.

Four groups appear within *Boiga* populations on Guam. Individuals less than 690 mm SV (Class I) are not yet sexually mature; individuals between 700 and 1150 mm SV (Class II) have begun to sexually mature or are mature at the larger end of the size range; individuals between 1160 and 1690 mm SV (Class III) are sexually mature; individuals greater than 1700 mm SV (Class IV) are also sexually mature but are exclusively male.

A combined (1984 to 1988) population structure analysis yielded the following data: Class I individuals comprised 16.4% of the population, Class II comprised 63.8% , Class III comprised 15.2%, and Class IV comprised 4.5%. Breaking this data down and analyzing by year gives a different picture and indicates trends (Table 1). The trend that emerges is of a size class shift. Class I numbers peaked in 1986 and have declined since, Class II numbers have been increasing since 1984, Class III have been decreasing since 1984, and Class IV numbers have attained former levels.

Sex Ratios

Data from 1984 to 1988 yielded the following information on sex ratios (Table 2). Any snake over 1150 mm SV is likely to be a male and any snake over 1700 mm SV will be a male. Analysis by year showed that the number of females in Class III has been declining since 1984. I am aware of only three Class III females collected between September 1986 and December 1988. Two of these were collected by myself in December 1988 but because of the low sample size, the sex ratio for this year class has been inflated.

Age and Growth

While growth data are currently unavailable for wild individuals, growth data for captive individuals (five males and four females) has been compiled. These snakes were held from 7 to 37 months in captivity and were weighed and measured at approximately one month intervals. Snakes were fed frequently so data generated from this would be a best case scenario. Presumably, if resources were abundant in the wild, growth in wild snakes would approach captive growth. Male captive *Boiga* were found to grow at an average of 7.5 mm per month while females average 7.3 mm per month. A single small female (750 mm SV initial) averaged 14.3 mm per month and may indicate that smaller snakes grow faster and growth slows through time. However, assuming these captive estimates would be the upper estimates for wild growth, then the following age ranges can be postulated: Class I is 0 to 25 months old, Class II is 25 to 57 months old, Class III is 57 to 95 months old, and Class IV is 95 to 146 months old. These figures were calculated using 14.3 mm per month as the most rapid growth. It should be safe to assume that growth in the wild is slower. If resources in the wild are limiting, then wild snakes are older than the ages speculated above.

Length/Weight Relationship

The relationship between length and weight is best described as curvilinear. The slope is essentially linear between 350 and 690 mm SV (Class I) and becomes increasingly curvilinear thereafter. From 1050 mm SV on, the slope becomes very steep. Juveniles at 350 mm SV weigh approximately 10 g while 690 mm SV individuals weigh approximately 42 g. Class II individuals at 700 mm SV weigh approximately 44 g and those at 1050 mm SV weigh about 117 g. Larger Class IV snakes weigh in at over two kg.

Reproduction

Follicular and testicular development generally begins in Class II snakes. The size at maturation of male snakes is unknown at this time. However, female maturation is relatively well documented. Follicular activity begins at approximately 700 mm SV but actual yolking of eggs does not start until 950 to 1050 mm SV. Yolked eggs do not appear to be shelled until they are ≥ 43 mm in length. Most females with shellable sized eggs are 1250 mm SV.

There is evidence to suggest that reproduction/copulation occurs over an extended period of time. Viable sperm in the oviducts has been collected in April, June, and October. Evidence also suggests that sperm storage occurs. A 950 mm SV female contained sperm in her oviducts yet all her follicles were less than 5 mm in length. Another female, 1250 mm SV, contained fertilized eggs yet had no sperm in the oviducts.

Recruitment

Despite the relatively large percentage of individuals in Class I, actual recruitment may be very low. Five years (1984 to 1988) worth of snake collecting has only produced six snakes (350 to 380 mm SV) that could be considered neonates. These have tended to appear at the end of the rainy season (September to January) although one was collected in April.

DISCUSSION

The population structure of *B. irregularis* on Guam appears to be abnormal. Comparative information on native populations is currently unavailable but the information summarized above shows that females are essentially missing in Class III and completely missing from Class IV. What little is known about the numbers of eggs laid (4-12) in *Boiga*'s native range gives a clue to fecundity in Guam *Boiga*. Females with shelled or shellable sized yolked follicles contained only three or four such bodies. This suggests that we are looking at the lower limit of reproductive potential in Guam *Boiga*. Females that could potentially lay 12 eggs would be Class IV.

Length/weight relationships are informative in that individuals larger than 1050 mm SV put on weight much quicker than smaller animals. This is in concert with reproductive data that suggests that egg size is ≥ 43 mm. Clearly, a thin bodied snake is not as well adapted to laying large eggs as a heavy bodied snake. Since these snakes become increasingly more heavy bodied, the trend is for them to become more terrestrial. Field observations indicate that larger snakes are found lower in the trees than smaller snakes. Most Class IV snakes are captured on the ground.

The above data are in concert with the apparent low recruitment. When female snakes reach reproductive size, they disappear from the population. It has long been known that clutches of *Boiga* eggs are relatively rare on Guam. The paucity of neonates reflects that rarity. It has been assumed that the rarity of eggs and neonates is a function of collecting bias, that is, researchers have been looking in the wrong places. The data now indicate that this rarity may be, in fact, real. Reproductively sized females are becoming increasingly rare in the population. The few that do survive may account for the low rate of recruitment.

It is appropriate to address the possibility that an as yet unidentified factor is in play in *Boiga* population dynamics. Starvation (loss of native bird populations and drop in small mammal populations) is likely a factor in the decline at the transition between Class II and

Class III snakes. However, this does not explain the loss of only one sex (females). It is evolutionarily unsound to consider that energy requirements of females during yolking would starve them during periods of limited resources. Instead, females generally shut down reproduction during periods of limited resources. The data suggest yet another possibility. It is well known that pesticides are stored in fat reserves. In females, these reserves are mobilized and metabolized for reproduction. If a species were carrying high pesticide loads, mobilization of these reserves would be harmful and could result in death. This scenario could explain the highly unusual sex ratios in Class III and IV snakes.

RECOMMENDATIONS

1. Continue all possible parameters of life history studies of *B. irregularis*.
2. Send off tissues for pesticide analyses.
3. Collect individual growth data via mark-and-recapture techniques.
4. Investigate movements of snakes by constructing at least two large 3-D grids in boonie areas.
5. Garner comparative data on native populations of *B. irregularis*.
6. Collect data on all lizard species on Guam. These now support the bulk of the snake population on Guam and almost nothing is known about their natural history.

Report prepared by: Michael James McCoid

Table 1. Population structure of *Boiga irregularis* on Guam through time. Population structure expressed in percentages.

Year	N	Class I <690 mm	Class II 700-1150 mm	Class III 1160-1690 mm	Class IV >1700 mm
1984	115	6.0	48.3	35.3	10.3
1985	284	16.2	65.5	14.4	3.8
1986	294	26.7	60.8	8.4	4.1
1987	77	10.9	79.4	9.6	0.0
1988	51	11.7	72.5	5.8	9.8

Table 2. Sex ratios (Females:males) of *Boiga irregularis* on Guam through time. Numbers in parentheses are sample sizes the ratio was calculated from.

Year	Class I <690 mm	Class II 700-1150 mm	Class III 1160-1690	Class IV >1700 mm
1984	1:0.5 (6)	1:1.43 (56)	1:4.7 (40)	0:1 (12)
1985	1:1.69 (43)	1:0.89 (188)	1:3.78 (43)	0:1 (11)
1986	1:1.08 (73)	1:0.87 (183)	1:7.33 (25)	0:1 (13)
1987	1:0.5 (9)	1:1.18 (61)	0:1 (6)	0:1 (1)
1988	1:0.5 (6)	1:1.28 (41)	1:2.5 (7)	0:1 (8)
Combined	1:1.22	1:1.06	1:4.8	0:1

**JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT**

STATE: Territory of Guam

PROJECT NO.: E-1-3

STUDY NO.: 7

JOB NO.: 2

JOB TITLE: Movements, Home Range and Activity Patterns of the Brown Tree Snake

PERIOD COVERED: October 1, 1987 to September 30, 1988

SUMMARY

No significant effort was expended on this job during this segment.

Report Prepared by: Gary J. Wiles

**JOB PROGRESS REPORT
RESEARCH PROJECT SEGMENT**

STATE: Territory of Guam

PROJECT NO.: E-1-3

STUDY NO.: 7

JOB NO.: 3

JOB TITLE: Development and Testing of Control Methods for the Brown Tree Snake.

PERIOD COVERED: October 1, 1987 to September 30, 1988

SUMMARY

No significant effort was expended on this job during this segment.

Report Prepared by: Gary J. Wiles

LAW ENFORCEMENT
Funding Source: Government of Guam

LAW ENFORCEMENT

A total of twenty-four persons were arrested and charged for the offense of illegal hunting. Of the above mentioned, one individual was intercepted by a Customs & Quarantine Officer at the Port Authority Pier upon docking. The arrested individual had in his possession four Marianas fruit bats, an Endangered Species. The vessels last known port of entry was Rota Island. The Division's Conservation Officers responded to the report and took over the investigation upon arrival. A report was submitted to the Attorney General's Office recommending charges against the individual.

The other twenty-three individuals were intercepted and were apprehended by the Conservation Officers while on their routine day and night patrol. Two of these individuals were minors. The first a male of age 17, was intercepted by Conservation Officers while on a routine patrol by Cross Island Road, Rt. 17. The individual was found in possession of dismembered deer meat. The Juvenile Authority and Guam Police Department (GPD) were both contacted regarding this matter. The Attorney General's Office prosecuted this individual through the Juvenile Court System and found him guilty of the offense. The minor was officially charged and fined for unlawful possession. Another male of age 17 was arrested in the Pago area for illegal fishing resulting from the capture of a hawksbill turtle, an Endangered Species. The individual was intercepted by an off-duty Conservation Officer. The Juvenile Authority and GPD were both contacted prior and after the individual was booked; he was then released to a guardian. A report has been submitted to the Attorney General's Office and awaiting prosecution.

Of the above twenty-four individuals (arrestees), four have already pleaded guilty and the rest of the cases are still pending due to the unavailability of prosecuting attorneys at the present time. Additionally, three vehicles were confiscated as evidence from individuals charged with transporting game carcasses illegally. Forfeiture actions were filed against these vehicles and all three vehicles were legally forfeited to the Department of Agriculture.

As a result of a forfeiture hearing regarding a four year old female carabao seized inside Naval Magazine on an alleged poaching incident, the Superior Court of Guam has decided that the carabao is not considered a vehicle in regards to the transport of illegally taken wildlife (deer carcasses).

Also as ordered by the Court, several weapons and other hunting paraphernalia have been forfeited to the Department of Agriculture. Although there is only one illegal fishing incident in FY 88, there were a number of reported incidents. Investigations were conducted immediately upon notification of potential illegal activities, but often upon arrival at a reported location no illegal activities or individuals could be identified.

In February of this year, three Conservation Officers were terminated due to their involvement in the shooting of a B-52 Bomber plane. After our loss of these officers we recruited two new personnel in June of 1988; shortly after which one of these new officers resigned. Although we are presently operating at a minimum staff level, we hope to recruit new personnel during the beginning of FY 89.

